CALIFORNIA INSTRUMENTS

MODEL 8420

DIGITAL
MULTIMETER/COUNTER

MP MASTER
MA28072

CALIFORNIA INSTRUMENTS
a division of
AIKEN INDUSTRIES, INC.

Revision A
September, 1972

INSTRUCTION MANUAL

MODEL 8420

DIGITAL

MULTIMETER/ COUNTER

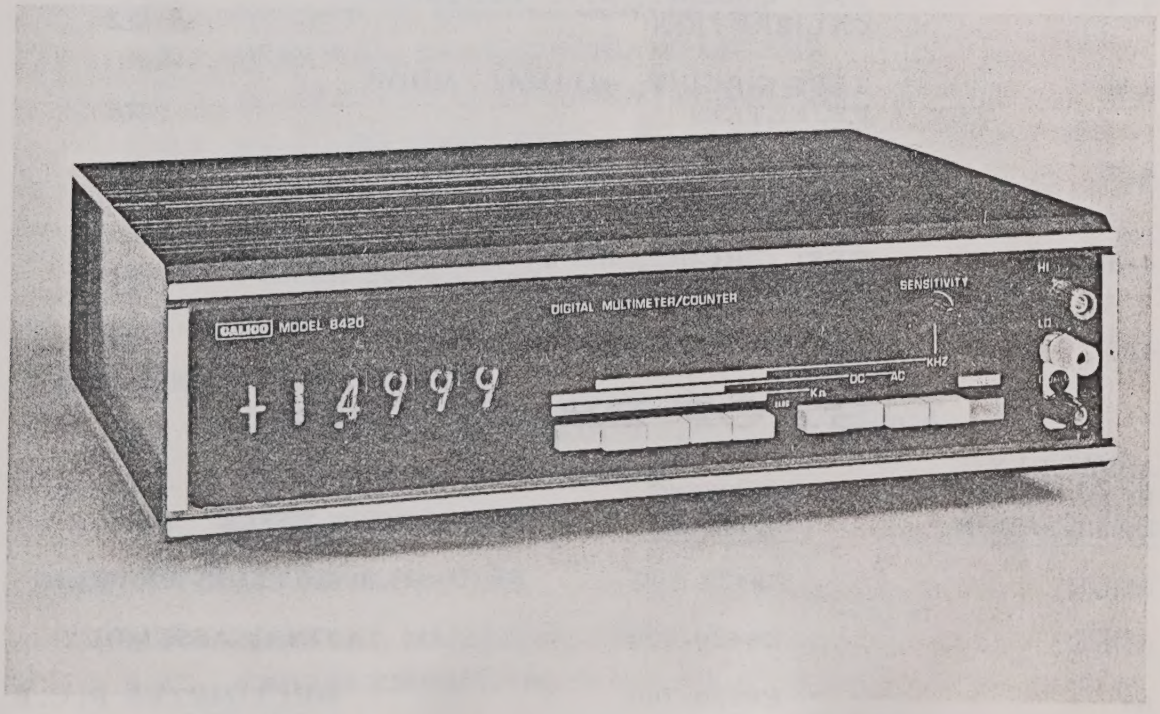

FIGURE 1-1

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ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
NONE	C8420-900	OUTLINE DRAWING
NONE	D8420-400	FINAL ASSEMBLY
A1	E8420-700	MULTIMETER P.C.B. ASSEMBLY
A1	E8420-070 (2 sheets)	UNIT SCHEMATIC

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SPECIFICATIONS

	DC	AC	KΩ	KHz
FULL SCALE	1, 10, 100, 1000V	1, 10, 100, 1000V	1, 10, 100, 1000, 10000KΩ	10, 100, 1000, 10000 KHz
ACCURACY for 90 days at 25°C ±5°C after 15 minutes warm-up	0.01% of reading ± 1 digit	0.1% of reading ± 3 digits from 60 Hz to 10 KHz 0.5% of reading ± 10 digits from 30 Hz to 50 KHz ±100 digits from 50KHz to 100 KHz	0.02% of reading ± 1 digit on 1 KΩ through 100 KΩ ranges 0.1% of reading ± 1 digit on 1 MΩ and 10 MΩ ranges	0.02% of reading ±1 digit from 50 Hz to 1MHz 0.05% of reading ± 2 digits from 50Hz to 10MH
RESOLUTION in % of full scale	0.01%	0.01% at 1KHz	0.01%	0.01% above 50 Hz
INPUT IMPEDANCE	10 Meghoms	1 Megohm in parallel with 50 pf nominal.	———	500 Kilohms in parallel with 75 pf nominal
NORMAL MODE REJECTION	50 db at 60 Hz ± .1%	———	———	———
COMMON MODE REJECTION	100 db DC to 60 Hz 80db DC with 100Ω unbal	60 db at 60 Hz with no unbalance	———	———
OVERRANGE	50% of full scale or 1000 VDC maximum, whichever is less.	50% of full scale or 500 VAC maximum, whichever is less	50% of full scale	50% of full scale or 10 MHz maximum, whichever is less.
OVERLOAD CAPABILITY	10,000 % of full scale but not to exceed 1000 VDC	10,000% of full scale but not to exceed 500 VRMS	200 VDC or peak AC	250 VRMS maximum
NOMINAL SOURCE CURRENT	———	———	1KΩ 6.2 milliamperes 10KΩ 620 microamperes 100KΩ 62 microamperes 1MΩ 6.2 microamperes 10MΩ 620 nanoamperes	———
READING RATE	3 per second (nominal)	3 per second (nominal)	3 per second (nominal)	1 per 2 seconds (nominal)
SENSITIVITY	———	———	———	0.1 VRMS from 50Hz to 1MHz 0.25 VRMS from 1 MHz to 10 MHz
AVERAGE TEMPERATURE COEFFIEIENT from 0°C to 55°C	± 0.002% of full scale per degree C	± 0.01% of full scale per degree C	± 0.005% of full scale per degree C	± 0.005% of full scale per degree C

OPERATING TEMPERATURE RANGE: 0°C to +55°C

STORAGE TEMPERATURE RANGE: -20°C to +85°C

MAXIMUM COMMON MODE VOLTAGE: 500 VDC or peak AC

POWER: 18 watts maximum, 115 VAC or 230 VAC ± 10%, 50 to 400 Hz

SIZE: 3-1/2"H x 13-1/4"W x 9-5/8"D

NET WEIGHT: 11 pounds

SHIPPING WEIGHT: 15 pounds

All specifications apply when tested in accordance with standard CALIFORNIA INSTRUMENTS test procedures.

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the CALICO Model 8420 Digital Multimeter/Counter. A photograph of the instrument is shown in figure 1-1.

1.2 DESCRIPTION

The CALICO Model 8420 Digital Multimeter/Counter measures DC voltage, AC voltage, resistance and frequency.

The ranges and functions are selected by push buttons located on the front panel.

The CALICO Model 8420 Digital Multimeter/Counter operates from 115 volts AC or 230 volts AC from 50 to 400 Hz, and consumes less than 18 watts.

1.3 EQUIPMENT SUPPLIED

The unit is shipped with the following:
1 - Belden #17258 power cord
1 - Littlefuse .125A
1 - Walsco 2525 alignment tool
1 - CALICO 8420 Instruction Manual

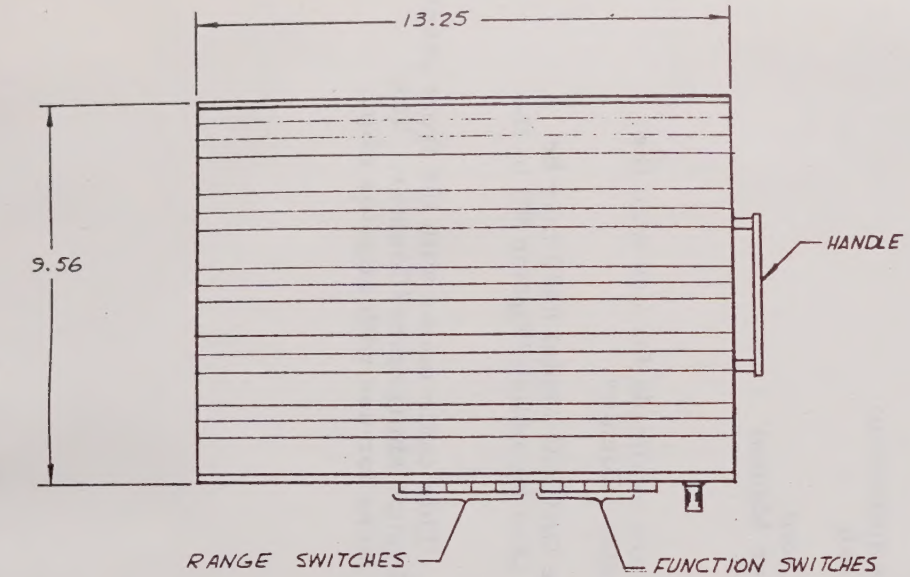
1.4 ACESSORY EQUIPMENT

The following accessories are available for use with the Model 8420 Digital Multimeter/Counter.

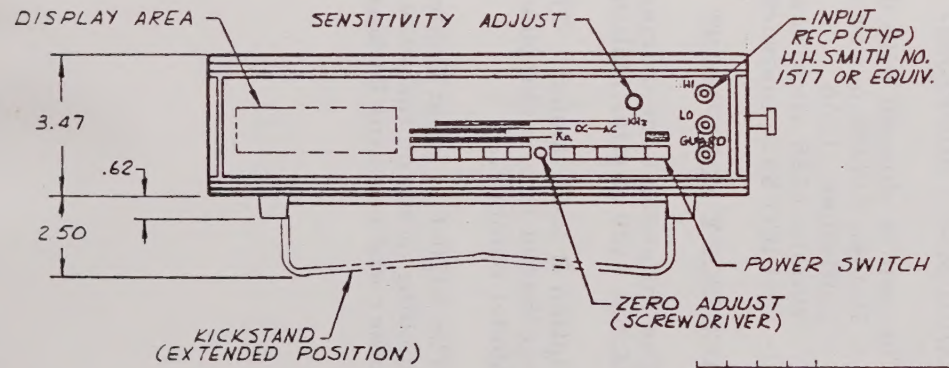
1.4.1 Option R Rack Mount. The CALICO Model 8420 may be purchased in a rackmount case by adding "Option R" to the Model number.

1.4.2 The 8420-800 Input Cable. This cable mates with the front panel binding posts on the 8420 Digital Multimeter/Counter. The other end contains banana jacks for use with aligator clips.

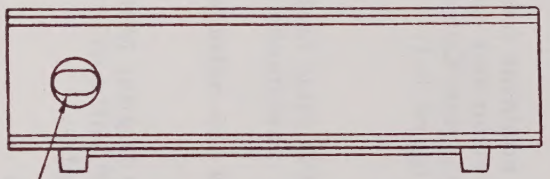
REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



FRONT VIEW
MODEL 8420



REAR VIEW



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES
TOLERANCES
XXX = .010
XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING, DIGITAL MULTIMETER/ COUNTER

MODEL 8420

RELEASE

CHECKER — PURCHASING

DESIGN — PROJ ENGR

DRFTSMN MARTIN M 7/7/71 — CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8420-900 REV -

SCALE 1/2 SHEET 1 OF 1

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

NOTES: (UNLESS OTHERWISE SPECIFIED)

C8420-900

CALICO F-302

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

2.1 UNPACKING

This instrument is shipped in a cardboard container with a protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

This unit operates from 115 VAC or 230 VAC ±10% at 50 to 400 Hz. The power consumption is less than 18 watts.

2.3 OPERATING CONTROLS

2.3.1 FRONT PANEL CONTROLS

2.3.1.1 RANGE SWITCH

The range switch is a five station, interlock, push button switch located in the middle of the front panel. The five ranges are 1, 10, 100, 1000, and 10,000. These ranges are direct multipliers for the units of measure used on the function switch, i.e., 1 VDC full scale, 1 KΩ full scale, etc.

2.3.1.2 FUNCTION SWITCH

The function switch is a four station, interlock, push button switch located on the right side of the front panel. These functions are DC voltage, AC voltage, resistance and frequency.

2.3.1.3 SENSITIVITY CONTROL

The sensitivity control is a variable attenuator located directly above the KHz function button. This control attenuates the incoming signal prior to processing by the frequency counter.

2.3.1.4 FRONT PANEL ZERO CONTROL

The front panel zero control is used to zero the preamplifier. The preamplifier is used on all DC and KΩ ranges.

2.3.1.5 POWER SWITCH

The front panel power switch is a push for ON: push for OFF type switch. It is located at the right end of the function switch.

2.3.2 INTERNAL CONTROLS

2.3.2.1 115 - 230 VOLT SWITCH

The 115 -230 volt slide switch is located near the right rear corner of thr printed circuit board. This switch allows the instrument to be operated from 115VAC or 230 VAC ± 10%. In order to operate the instrument from 115 volts AC, switch to the 115 position and install a 0.25 ampere slow blow fuse. To operate the instrument from 230 VAC, slide the 115 -230 switch to the 230 position and install a 0.125 ampere slow blow fuse.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If any damage is evident, notify the carrier, DO NOT return the instrument to the factory without prior approval. If the unit appears to be in good condition, perform the following.

a) Connect a wattmeter between the AC power input to the instrument and the AC line.

NOTE

The Model 8420 Digital Multimeter/ Counter is shipped from the factory ready to operate from 115 VAC. For 230 VAC operation consult section 2.3.2.1 of this instruction manual.

b) Turn the unit on and check that the power does not exceed 18 watts. Allow 15 minutes for the unit to warm up.

c) Short the inputs together. Select the DC function and the 1 range. Check that the display reads all zeros. If the display does not read all zeros adjust the front panel zero control.

d) Using a COHU Model 351 precision DC standard, or equivalent, connect the Model 8420 Digital Mulimeter/Counter input to the output of the DC standard. Adjust the DC standard to 1.0000 volt DC ± .003%. The display should read 1.0000 ± 2 digits.

e) Select the AC function and the 1 range. Connect the Model 8420 Digital Multimeter/Counter input to the output of a H.P. 745AC calibrator or equivalent. Adjust the AC calibrator output to 1.0000 volt rms ±0.02% at 1KHz. The display should read 1.0000 ± 13 digits.

f) Select the KΩ function and the 1 range. Connect the input leads to a precision 1000 ohm ± 0.005% resistor. The display should read 1.0000 ± 3 digits.

If further evaluation is required, see section 4.0 of this instruction manual.

2.5 INSTALLATION

The CALICO Model 8420 Multimeter/Counter may be bench mounted or rack mounted. To rack mount this instrument, add OPTION R to the model number at the time of purchase.

Although no cooling fans are required, the unit should be installed so that the normal flow of air is not obstructed. Care should also be taken not to install the unit in areas where excessive heat is produced by other equipment.

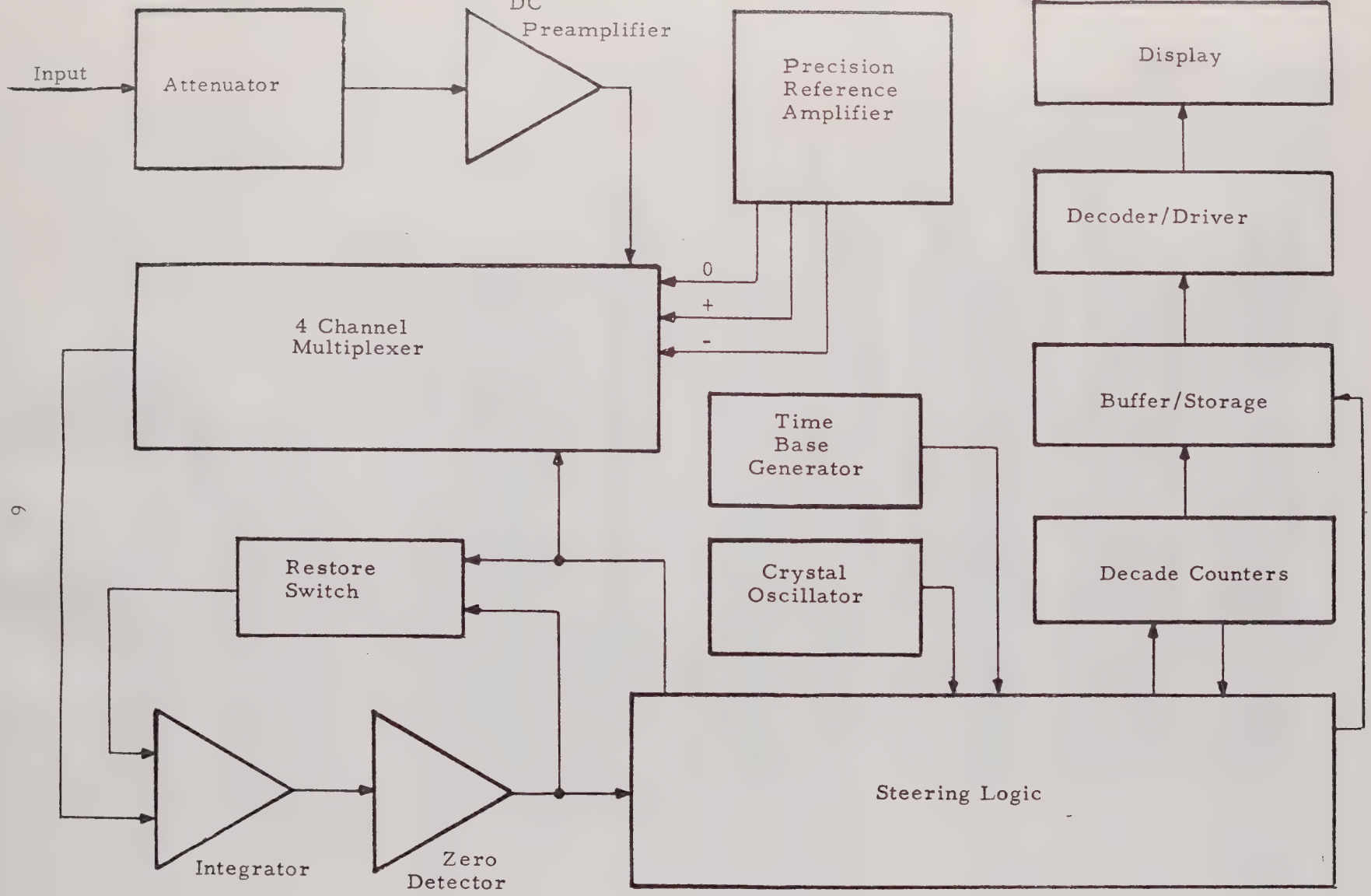


FIGURE 3-1 Functional Block Diagram For Model 8420 Digital Multimeter

THEORY OF OPERATION

3.1 GENERAL

The CALICO Model 8420 Digital Multimeter/Counter is a precision digital voltmeter that measures DC voltage. A block diagram that illustrates the theory of operation is shown in Figure 3-1. The measurement of AC volts and ohms is accomplished by first converting these inputs to a DC voltage then measuring the DC voltage. The measurement of frequency is accomplished by counting the unknown input frequency with the decade counters for a fixed period of time.

The analog to digital conversion process is accomplished by a three step integrator, as shown in figure 3-2. The first step is the restore mode. In this mode one input to the integrator is connected to ground and a feedback signal is applied to the other input. This automatically adjusts out any offset voltage in the integrator.. The second step begins with the receipt of an encode start pulse from the time base generator. This resets the decade counters to all zeros and opens the gate to the crystal oscillator. At this same time the input to the integrator is connected to the analog input signal. The output of the crystal oscillator continues to feed the decade counters until they count through 9999 and back to 0000. At this point the analog voltage from the preamplifier is removed from the integrator input and the proper reference voltage from the reference amplifier is applied to the integrator input throught the multiplexer. This reference voltage is selected to be of the opposite polarity to the analog input voltage. This drives the output of the integrator back toward zero. As the output of the integrator passes through zero, the output of the zero detector changes state. This closes the gate to the crystal oscillator and transfers the data accumulated in the decade counters into the storage register for display. At this same time the instrument is returned to the restore mode.

3.2 DETAILED CIRCUIT DESCRIPTION

The schematic diagram for all of the electronics in the CALICO Model 8420 Digital Multimeter/Counter is contained in drawing numbdr E8420-070 which is divided into two sheets. The digital logic used in this instrument is of the TTL type. The "0" state is defined to be between 0 and +.4 volts DC and the "1" state is defined to be between +2.4 and +5 volts DC. Figure 3-3 illustrates a truth table for the four logic gate functions which are used in this instrument.

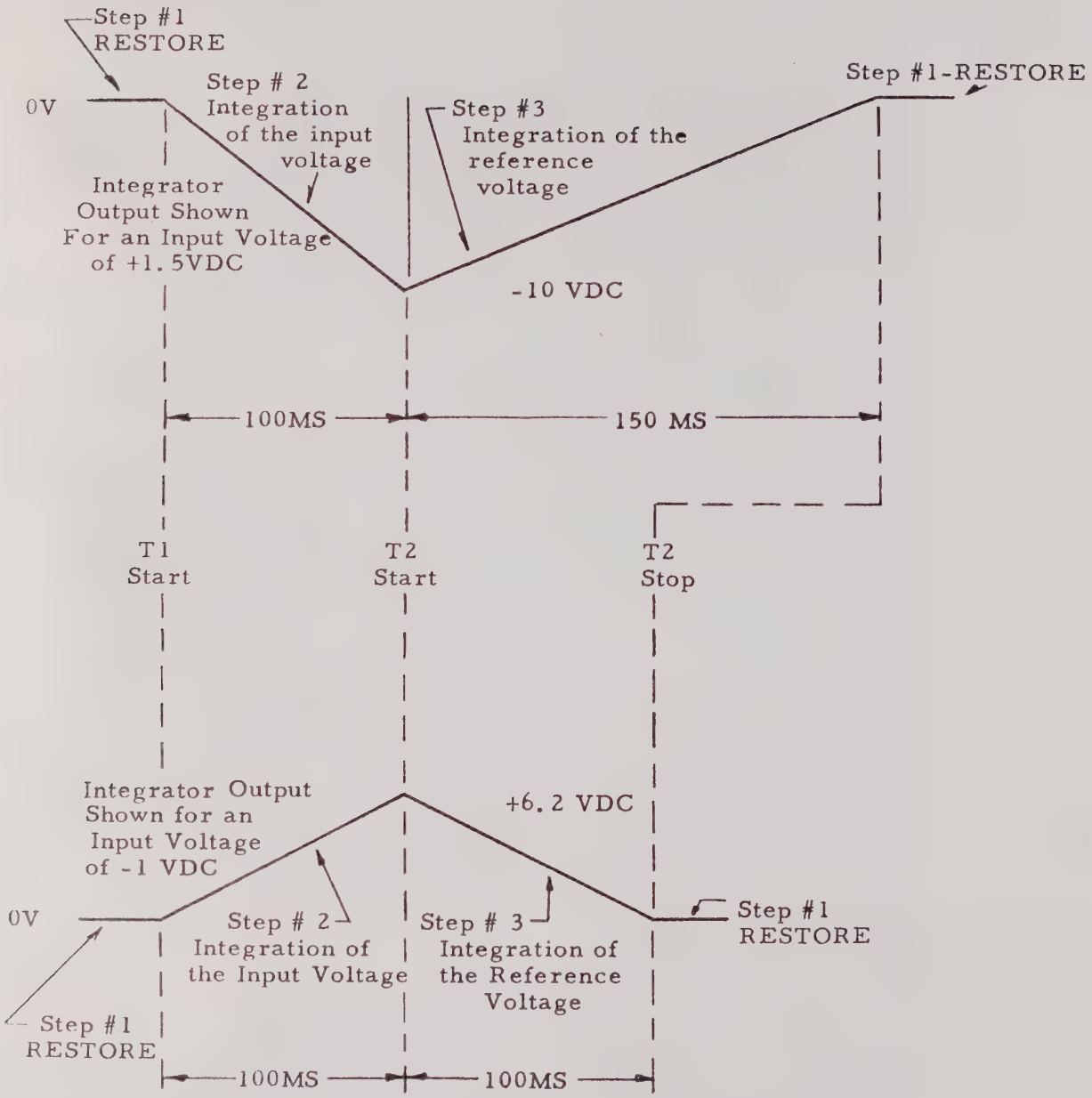
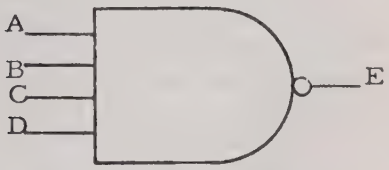


Figure 3-2 Timing Diagram for
Model 8420 Digital Multimeter/Counter

2 INPUT NAND GATE

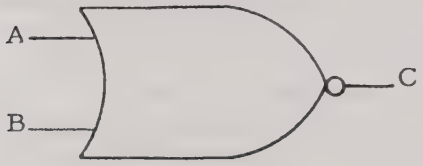
A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

4 INPUT NAND GATE



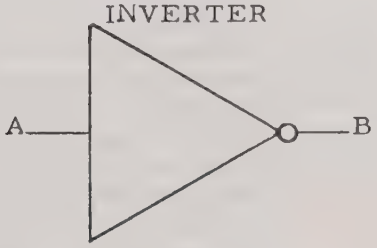
A	B	C	D	E
0	0	0	0	1
1	0	0	0	1
1	1	0	0	1
1	1	1	0	1
1	1	1	1	0

2 INPUT NOR GATE



A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

INVERTER



A	B
0	1
1	0

FIGURE 3-3 TRUTH TABLE FOR LOGIC GATES USED IN MODEL 8420 DIGITAL MULTIMETER/ COUNTER

3.2.1 ANALOG TO DIGITAL CONVERTER

The Model 8420 Digital Multimeter/Counter uses a three step integration process for comparing an unknown input voltage to a precision internal reference voltage.

Step one of this process is the RESTORE mode. In this mode a "1" level is present at pin 3 of IC37. This drives the output of IC37, pin 6, to +15 volts. This, in turn, back biases CR18 and CR21, causing Q14 and Q16 to turn "on". Transistor Q14 grounds the input to the integrator, IC32 and Q10, through R59 and R60. Transistor Q16 closes a feedback loop from the zero detector, IC31 and Q15, back to the non-inverting input of the integrator, Q10 gate 2. This feedback loop removes any offset voltage that exists in the integrator or zero detector. The instrument will remain in this mode until acted upon by an encode enable pulse.

Step number two begins as the unijunction oscillator, Q4, produces an encode enable pulse. This pulse is fed into a differentiator formed by C12, R19 and Q5. The output of this differentiator, IC5 pin 13, is a negative going pulse 2 microseconds wide. This produces a positive pulse at IC5 pin 12. This pulse is used to reset the decade counters to all zeros. It is also used to set IC30 pins 1 and 4 to the '0' state. This in turn opens the gate on the output of the 1 MHz crystal oscillator, IC27-B. At this same time IC30 pin 10 goes to the "1" state which drives IC38 pin 6 to +15 volts DC. This turns Q13 "on" thus connecting the unknown input voltage to the input of the integrator. For the purpose of this explanation it will be assumed that the instrument is in the DC function and has a + full scale voltage applied on the unknown input. This will cause the integrator output (the junction of R46 and C21) to start ramping negative. Since the DC function was selected this places a "1" at IC4 pin 9 and a "0" at IC4 pin 12. This allows the 100 KHz output from IC26 pin 11 to be fed through to the decade counter input at IC3 pin 14. The unit Will remain in this mode until the decade counters have counted up to 09999. The act of the counters advancing to 10000 starts step 3. Since the unknown input voltage is positive this drives the output of the zero detector, collector of Q 15, to the "1" state. Thus setting IC16 pin 1 to the "1" state and IC16 pin 4 to the "0" state.

Step three begins when IC25 pin 12 goes to the "1" state. This sets IC30 pin 10 to the "0" state and IC30 pin 4 to the "1" state. This drives IC33 pin 13 and IC16 pin 13 to the "0" state, thus holding the polarity data contained in IC16A and B. At the instant the third step begins there is a negative going polarity interogate pulse at IC29 pin 3. If the unknown input voltage is positive this will produce a positive going pulse at IC29 pin 1. This drives the polarity display flip-flop formed by IC29B and C. If the unknown input voltage is negative no pulse will occur.

Since IC29 pins 11 and 12 are in the "0" state this drives IC5 pin 2 to the "0" state. This enables the polarity data contained in IC16A and B to be fed into IC33B and C. This causes a "1" state to occur at IC33 pin 4 which drives IC35 pin 6 to +15 volts DC. This turns Q11 'on' connecting the negative reference voltage to the input of the integrator. This causes the output of the integrator to start ramping back toward zero. As the output of the integrator passes through zero the output of the zero detector, collector of Q15, changes to a "0" state. This drives the output at IC27 pin 13 to the "0"state; which in turn sets IC30 pin 13 to the "0" state. This produces a positive-going pulse at IC5 pin 10 which transfers the data accumulated in the decade counters into the storage register for display. At this same time IC30 pin 1 goes to the "1" state which stops the output of the crystal oscillator and drives IC37 pin 6 to +15 volts returning the instrument to the restore mode.

3.2.2 PRECISION REFERENCE AMPLIFIERS

The precision reference amplifier consists of two operational, integrated circuit amplifiers IC28 and IC34. The first amplifier, IC28 has a temperature compesated zener diode in its negative feedback loop, CR11. This produces an output at the cathode of CR11, of +6.2 volts DC. This output is applied to the second amplifier IC34 which is operated as a gain of -1.0 amplifier. This produces an output of -6.2 volts DC at the anode of CR15. This output is applied through R27 to the summing junction of the first amplifier. Since the gain of the second amplifier is -1.0, the current that flows through CR11 is the zener voltage of CR11 divided by the resistance of R27. The amplifiers IC28 and IC34 are unable to provide the full amount of this current and it is supplied through R28 and R47 from the + and - 15 volt DC supplies. The +6.2 and -6.2 volt reference outputs are used to drive two of the four inputs of the multiplexer.

3.2.3 DC PREAMPLIFIER AND ATTENUATOR

The DC preamplifier consists of Q22 and IC42. Dual transistor Q22 is used as a differential source follower, driving the inputs to an integrated circuit amplifier IC42. The DC preamplifier is operated as a potentiometric amplifier with a gain of approximately 6.2. The gain determining feedback resistors are R140, R141, R145 and R149. A tracking ±6 volts DC power supply is used tosupply power to the input transistor Q22. This supply is generated by driving an integrated circuit voltage follower, IC40, from the gain of one feedback point associated with the DC preamplifier. This produces a low impedance voltage source, that tracks the input signal. This output, IC40 pin 6, is used to drive two 6 volt zener diodes CR32 and CR33, thus producing a ± 6 volt DC supply that tracks the input signal.

The DC input attenuator consists of R78, R80, R81, R89, R91, R100, R101, R109, R110, R111, and R115. This attenuator provides attenuations of 10:1 (R101 ARM), 100:1 R91 ARM) and 1000:1 (R81 ARM). This attenuator is also used on the KΩ function. Its use, related to the KΩ function, will be explained under section 3.2.5 Ohms to Volts Converter.

3.2.4 AC TO DC CONVERTER

The AC to DC converter consists of Q20, Q21, IC41, IC43, and IC44. It provides an output of -6.2 volts DC at IC43 pin 6 for an input of 1 volt rms at the gate of Q20. Full scale inputs of 10 volts AC, 100 volts AC and 1000 volts AC are fed through AC attenuators to provide 1 volt AC prior to feeding this signal into Q20. Q20 and Q21 form a gain of one amplifier that has a high input inpedance and a low output impedance. Integrated circuit IC41, CR38 and CR39 form an operational rectifier with a differential output. The positive half wave rectified output comes from the cathode of CR39 through R146 into the summing junction of the output amplifier. The negative half wave rectified output comes from the anode of CR38 through R160 into the inverting amplifier IC44. The output of the inverting amplifier at IC44 pin 6, produces a positive half wave output that is 180° out of phase with the positive half wave output at the cathode of CR39. These two signals drive the same summing junction, IC43 pin 2, of the operational output filter, The resulting output of the operational output filter, IC43 pin 6, is a DC level that is proportional to the amplitude of AC input voltage. Capacitor C55 is used to remove the ripple for the output of the AC/DC converter.

3.2.5 OHMS TO VOLTS CONVERTER

A block diagram for the Ohms to Volts Converter is shown in Figure 3-4. This converter consists of, the ohms reference amplifier, IC39 and Q19, and the same attenuator network and preamplifier that is used on the DC volts function. The DC preamplifier is operated as a operational amplifier, with the unknown resistor Rx in the negative feedback loop. The input resistor to this amplifier is formed by the attenuator network. The test current that flows in the unknown resistor is set by, the output voltage of the ohms reference amplifier, divided by the attenuator resistance for the selected range. For example, on the 10 KΩ range, the attenuator resistance is 10KΩ and assume the reference voltage to be 6.200 volts DC,then the test current would be 620.0 microamperes. If the unknown resistance is 10KΩ then the DC preamplifier output voltage at S1-A-9 would be 6.200 volts DC. This would in turn produce a reading of 10.000 in the display.

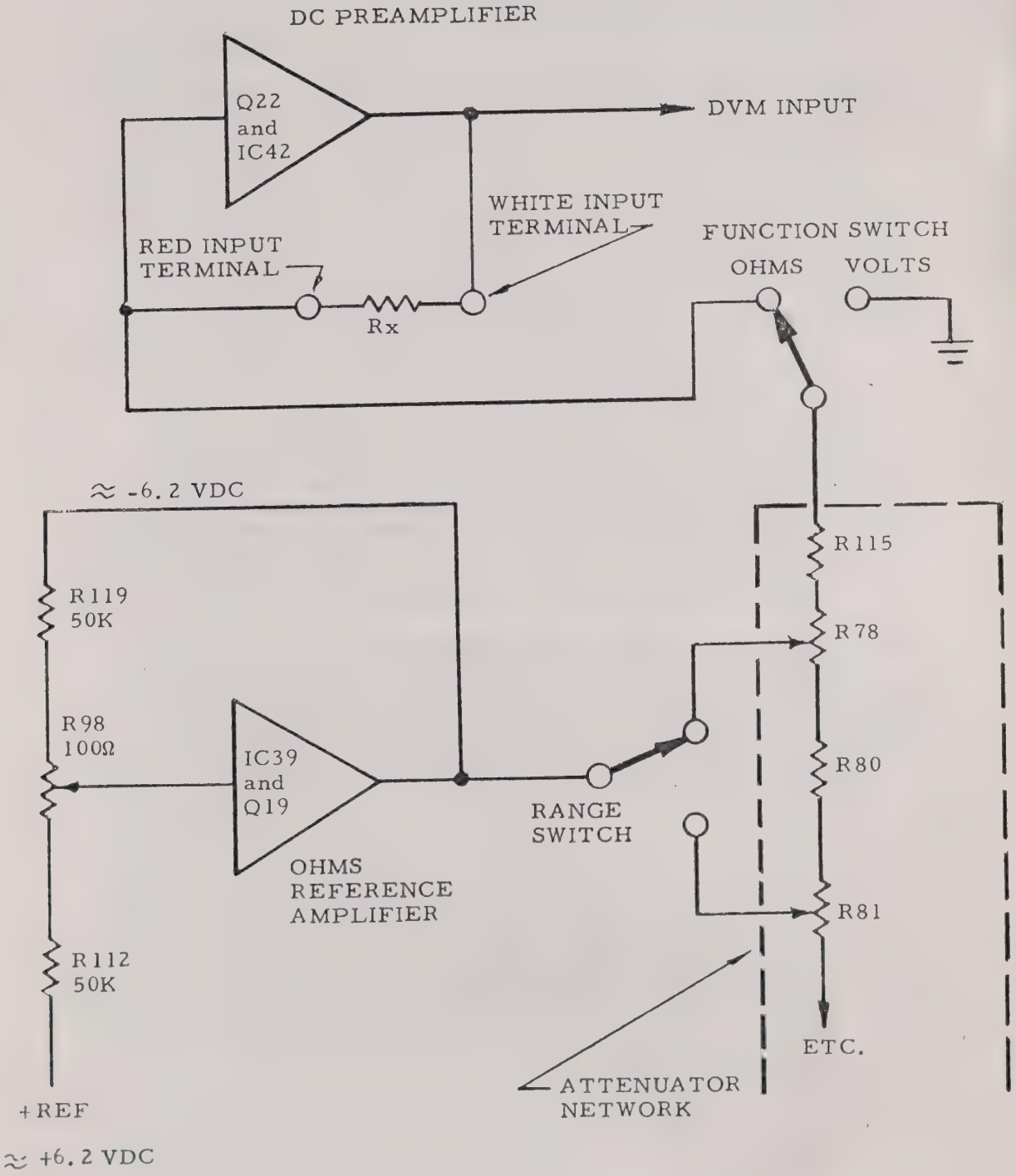


FIGURE 3-4. BLOCK DIAGRAM OHMS TO VOLTS CONVERTER.

3.2.6 FREQUENCY COUNTER

The frequency counter uses the circuitry of the basic analog to digital converter. The crystal oscillator is fed through two divide by 10 counters, IC26 and IC23, to produce a master clock frequency of 10 KHz. The analog input voltage is derived from the precision reference supply, IC28, and is fed through the ohms/frequency reference amplifier, IC39 and Q19. Since the analog input voltage is equal to the reference voltage,the time required to complete steps 2 and 3 of the integration process will be equal. The time of step 2 is set by feeding the 10KHz master clock into the decade counters until they have accumulated 10000 counts. This produces an integration time of one second. Since in this mode step 3 will also equal one second, feeding the unknown input frequency into the decade counters during this time will produce a reading equal to the unknown input frequency.

The unknown frequency input is fed into the front panel sensitivity control, R2. This control is a variable attenuator that provides from 0 to 60db of attenuation. The output of this attenuator is fed into the frequency-input amplifier, Q17 and Q18. This amplifier converts small amplitude sine waves into square waves of a drive level compatible with TTL logic. The output of this amplifier, Q18 pin 14, is fed into a latching amplifier formed by IC15A and B.

The purpose of the latching amplifier is to produce fast rise time square waves that do not contain noise. This is done by feeding the square waves from the input amplifier through R20 into IC15 pin 2, and applying positive feedback from IC15 pin 4 back to IC15 pin 2, through R17. The fast rise time square waves from the latching amplifier output, IC15 pin 4, are fed into a series of three divide by 10 counters, IC7, IC11 and IC18. These counters drive a series of four range selection gates, IC6. Pressing one of the four front panel push button range switches will enable the corresponding range selection gate. For example, pressing the 1000 KHz range button will enable IC6-C. This will produce a division ratio of 100:1 from the input frequency. Thus an unknown input frequency of 1 MHz would be scaled down to 10 KHz and fed into the decade counters during step three,of the conversion process. At the conclusion of step three,the counts accumulated in the decade counters are transferred into the storage register for display.

3.2.7 POWER SUPPLIES

The power transformer has a split primary and may be operated from 115 VAC or 230 VAC ± 10%. (Selectable by the 115-230 switch S2).

Secondary S1 provides 180 volts rms AC ± 10% at a current of 0.018 amperes rms. This is half wave rectified by CR1 for the use as the anode supply for the display tubes.

Secondary S2 drives a full wave silicon diode bridge, CR2, CR3, CR4, and CR5. The output of this bridge drives two 250 microfarad capacitors and provides ± 25 volts DC ± 10% with approximately 1.3 volts peak-to-peak ripple. These voltages are regulated down to +15 volts DC and -16 volts DC ± 10% with a series type regulator. The +15 volts DC regulator consists of Q2, CR8, and R9. The -16 volts DC regulator consists of Q3, CR9, R11 and R10.

Secondary S3 is a center taped winding that is full wave rectified by two silicon diodes, CR6 and CR7. This rectified output is filtered by a 4000 microfarad capacitor, C7, to provide +8 volts DC ± 10% with approximately 1.2 volts peak-to-peak ripple. This output drives an integrated circuit voltage regulator, IC19, which provides an output between +4.75 and +5.25 volts DC.

3.2.8 OVERLOAD INDICATOR

The overload indicator consists of IC45, Q23 and DS7. This indicator illuminates any time the display reads 15000 or higher. The BCD outputs from the thousands and tenthousands storage registers are decoded by IC45, to provide a "1" output for readings of 15000 and higher. The "1" output, at IC45 pin 10, is used to provide base drive to Q23. As Q23 turns "on", its collector current flows through DS7 causing the light to illuminate.

NOTE

In the FREQUENCY mode it is possible to exceed the 19999 digit capacity of the display. If this should occur the overload indicator will not provide the proper indication.

Figure 4-9 shows the location of all internal adjustments required to calibrate the Model 8420 Digital Multimeter/Counter.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

4.1 TEST EQUIPMENT REQUIRED

a) DC Voltage Standard: Cohu 351 or equivalent
b) AC Voltage Standard: Hp 745 and 746 or equivalent
c) Frequency Counter: Hp 5323A or equivalent
d) Oscillator: Hp 5323A or equivalent
e) Resistance Standards: 1KΩ, 10KΩ, 100KΩ, 1MΩ, and 10MΩ ±0.005%
f) AC Wattmeter: Triplett 661 or equivalent
g) Variac: Superior Electric 216 or equivalent
h) Microammeter: Hp 425 or equivalent
i) Oscilloscope: Tektronix 535 with L preamp or equivalent
j) Frequency standard: Hp 105A or equivalent

4.2 CALIBRATION PROCEDURE

The following calibration procedure may be preformed on a routine basis to insure that the unit remains within specified tolerance. This procedure should always be performed after any repairs are made on the basic accuracy determining circuitry. Before calibrating the unit, apply AC power and allow one hour to permit the internal circuitry to stablize.
This procedure covers the following adjustments:
a) Zero adjustment of A-D converter
b) Zero adjustment of input amplifier
c) Calibration of A-D converter
d) Zero adjustment of AC to DC converter
e) Calibration of AC to DC converter
f) Calibration of ohms converter
g) Calibration of frequency counter

The calibration procedure should be preformed as follows:

4.2.1 Select the DC function and the 1 range. Connect a microammeter to the input terminals, as illustrated in figure 4-1.

Adjust the front panel zero control R130 until the microammeter reads less than 50 picoamperes. Remove the microammeter and short the input terminals, of the Model 8420 Digital Multimeter/Counter, together. Adjust R69 until the display reads ± .0000.

4.2.2 Connect the input to a precision DC voltage standard, as shown in Figure 4-2. Adjust the DC voltage standard to provide a output of -1.0000 volt DC ± 0.003%. Adjust R149 until the display reads -1.0000.

4.2.3 Adjust the DC voltage standard to provide an output of +1.0000 volt DC ± 0.003%. Adjust R42 until the display reads +1.0000.

4.2.4 Select the 10 range and apply an input voltage of +10.000 volts DC ± 0.003%. Adjust R101 until the display reads +10.000.

4.2.5 Select the 100 range and apply an input voltage of +100.00 volts DC 0.003%. Adjust R91 until the display reads +100.00.

4.2.6 Select the 1000 range and apply an input voltage of +1000.00 volts DC ± 0.003%. Adjust R81 until the display reads +1000.00.

4.2.7 Connect the input terminals of the Model 8420 Digital Multimeter/Counter to a resistance standard of 10,000 ohms ± 0.005%, as shown in figure 4-3. Select the 10 range and the KΩ function. Adjust R98 until the display reads 10.000.

4.2.8 Select the 1 range and connect the input of the Multimeter/Counter, to a resistance standard of 1000.0 ohms ± 0.005%. Adjust R78 until the display reads 1.0000.

4.2.9 Select the 10 range and the KHz function. Apply an input of 10000 Hz ± 0.005% at 1 volt rms, as shown in figure 4-4. Adjust R99 until the display reads 10.000.

4.2.10 Select the 1 range and the AC function. Short the input terminals of the Multimeter/Counter together. Adjust the R147 until the display reads .0000.

4.2.11 Connect the input terminals of the Model 8420 Digital Multimeter/Counter to the output of the AC voltage standard, as shown in figure 4-5. Adjust the AC voltage standard to an output of 1.0000 volt rms ± 0.02% at a frequency of 100Hz. Adjust R 157 until the display reads 1.0000 ± 2 digits.

4.2.12 Apply an input of 1.000 volt rms ± 0.1% at a frequency of 100KHz. Select a value for C49 to provide a reading of 1.0000 ± 30 digits.

4.3.1 OVERLOAD INDICATION

Select the DC function and the 1 range. Connect the input to a DC voltage source. Adjust the DC voltage source until the multimeter reads 1.5000. At this reading the overload indicator should illuminate.

4.3.2 INPUT IMPEDANCE

Select the DC function and the 1 range. Connect the input to a DC voltage source. Adjust the DC voltage source until the display reads 1.0000. Connect a 10KΩ ± 1% resistor in series with the high input lead. The reading should be .9990 ± 1 digit.

4.3.3 NORMAL MODE REJECTION

Select the DC function and the 1 range. Connect the multimeter input to the output of a sine wave generator, as shown in figure 4-6. Adjust the output of the sine wave generator to 0.064 volts peak-to-peak at 60.0 Hz ± .1%. The display should read .0000 ± 1 digit.

4.3.4 COMMON MODE REJECTION

Select the DC function and the 1 range. Short all three input terminals together, connect them to the high output of a sine wave generator. Connect the low output of the sine wave generator to the power line ground, as shown in Figure 4-7. Adjust the output of the sine wave generator to 20 volts peak-to-peak at 60 Hz. The display should read .0000 ± 1 digit.

Select the DC function and the 1 range. Connect a 100 ohm 1% resistor between the high input lead and the low input lead. Remove the guard strap and connect a jumper wire between the high input terminal and the guard. Connect the high output of the sine wave generator to the high input of the Model 8420 Digital Multimeter/Counter. Connect the low output of the sine wave generator to power line ground. Adjust the output of the sine wave generator to 2.0 volts peak-to-peak at 50 to 60 Hz. The display should read .0000 ± 1 digit.

4.3.5 INPUT SENSITIVITY IN FREQUENCY MODE

Select the KHz function and the 1000 range. Set the front panel sensitivity control fully clockwise. (Early versions of the Model 8420 Digital Multimeter/Counter may not have this control). Apply an input of 1.0000 MHz ± 0.005% with an amplitude of 0.1 volt rms ± 1%. The multimeter should read 1000.0 ± 3 digits. Select the 10000 range. Apply an input of 10.000 MHz ± 0.005% with an amplitude of 0.25 volt rms ± 1%, as shown in Figure 4-4. The display should read 10000. ± 7 digits.

4.2.13 Select the 10 range and apply an input of 10.000 volts rms ± 0.02% at a frequency of 100 Hz. Adjust R85 until the display reads 10.000 ± 2 digits.

4.2.14 Apply an input of 10.000 volts rms ± .02% at a frequency of 10 KHz. Adjust C36 until the display reads 10.000 ± 10 digits and that with a 100 KHz 10 volts ± 0.1% input signal the display will read 10.000 ± 80 digits.

4.2.15 Select the 100 range and apply an input of 100.00 volts rms ± 0.02% at a frequency of 100 Hz. Adjust R95 until the display reads 100.00 ± 2 digits.

4.2.16 Apply an input of 100.00 volts rms ± 0.02% at a frequency of 10 KHz. Adjust C39 until the display reads 10000 ± 10 digits and that with a 100 KHz 10 volts ± 0.1% input signal the display will read 10.000 ± 80 digits.

4.2.17 Select the 1000 range and apply an input of 500.0 volts rms ± 0.02% at a frequency of 100 Hz. Adjust R106 until the display reads 500.0 ± 2 digits.

4.2.18 Apply an input of 500.0 volts rms ± 0.02% at a frequency of 10 KHz. Adjust C42 until the display reads 500.0 ± 5 digits and that with a 100 KHz 10 volts ± 0.1% input signal the display will read 10.000 ± 80 digits.

CAUTION

The maximum safe input voltage, on the AC function is 500 volts rms.

4.3 TEST PROCEDURE

The following test procedure, or any part of it, may be performed as required. This procedure should only be performed after completing 4.2 CALIBRATION PROCEDURE. This test procedure covers the following specifications for the digital multimeter:

1) Overload indication
2) Input impedance
3) Normal mode rejection
4) Common mode rejection
5) Input sensitivity in frequency mode
6) Resolution
7) Temperature coefficient
8) Line voltage range

NOTE

For all of the following tests the input low lead must be connected to the guard lead at the front panel.

4.3.6 RESOLUTION

Select the DC function and the 1 range. Apply an input of 0.1000 volt DC, as shown in Figure 4-2. Vary the input by precisely 100 microvolts and check that the reading changes 1 digit.

4.3.7 TEMPERATURE COEFFICIENT

Select the DC function and the 1 range. Place the unit in an environmental chamber at 25°C and allow a minimum of one hour for the unit to stabilize. Apply both + and - 1.0000 volt DC ± 0.005% and record the readings. Check that the front panel zero control is properly set to read .0000. Raise the temperature in the chamber to +55°C and allow a minimum of one hour for the unit to stabilize. Check zero and adjust if necessary. Apply both + and - 1.0000 volt DC ± 0.005% and check that the readings previously taken have not changed more than ± 6 digits. The Model 8420 Digital Multimeter/Counter should be connected as shown in Figure 4-2 for this test.

4.3.8 LINE VOLTAGE RANGE

The following line voltage tests are made around 115 volts AC 60 Hz. If the unit is to be used on 230 volts AC or other than 60 Hz, the test should be performed at that voltage or frequency.

Connect the variac to the 115 volt DC 60 Hz line. Connect the wattmeter/voltmeter to the output of the variac and connect the 8420 to the wattmeter/voltmeter output, as shown in Figure 4-8. Apply a full scale 1.0 volt DC input voltage to the Model 8420 Digital Multimeter/Counter. Vary the AC line voltage from 103.5 to 126.5 volts AC and check for a 1 digit or less change in the reading.

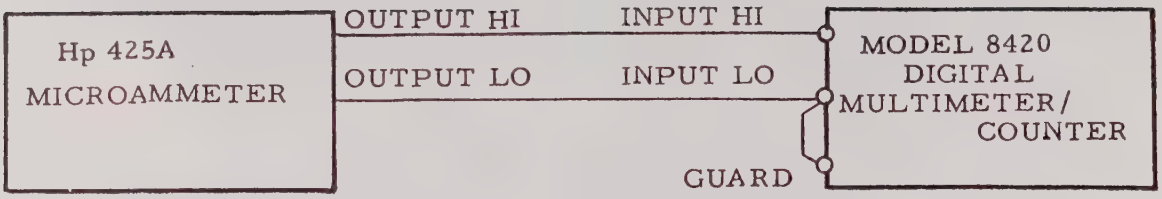


FIGURE 4-1
INPUT CURRENT TEST CIRCUIT

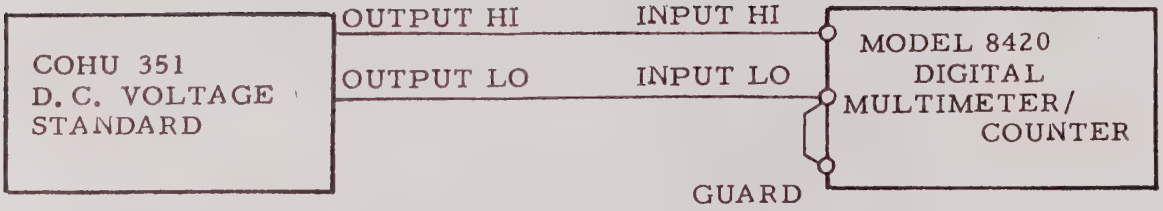


FIGURE 4-2
D. C. VOLTAGE CALIBRATION TEST CIRCUIT

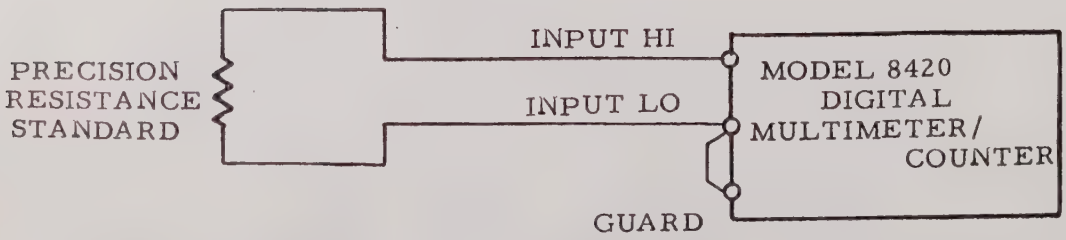


FIGURE 4-3
RESISTANCE CALIBRATION TEST CIRCUIT

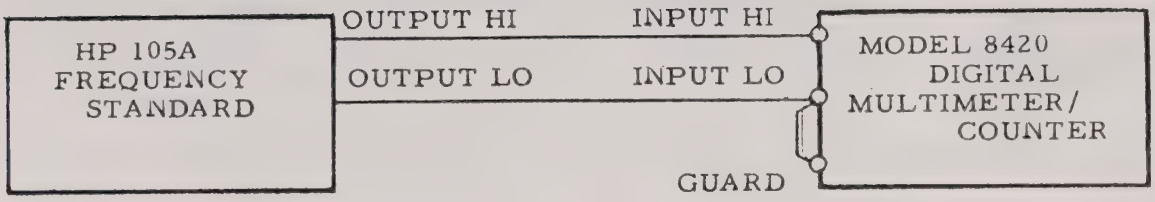


FIGURE 4-4
FREQUENCY CALIBRATION TEST CIRCUIT

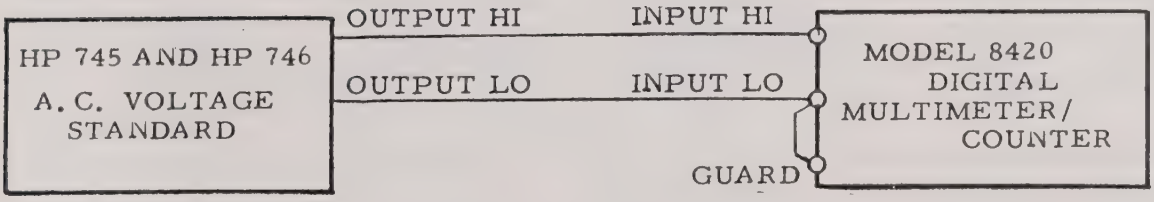


FIGURE 4-5
A.C. VOLTAGE CALIBRATION TEST CIRCUIT

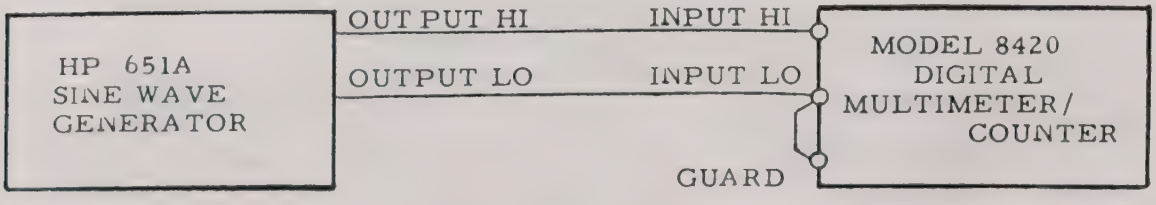


FIGURE 4-6
NORMAL MODE REJECTION TEST CIRCUIT

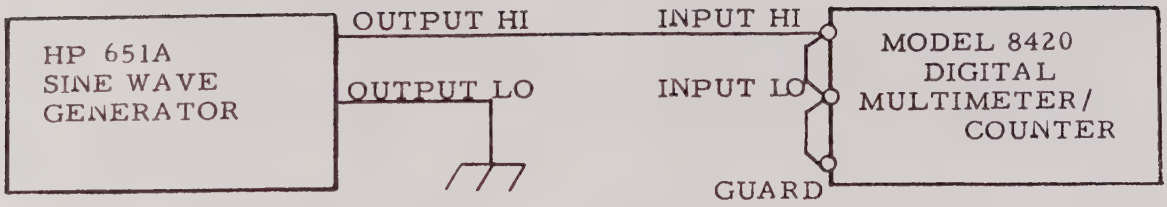


FIGURE 4-7
COMMON MODE REJECTION TEST CIRCUIT

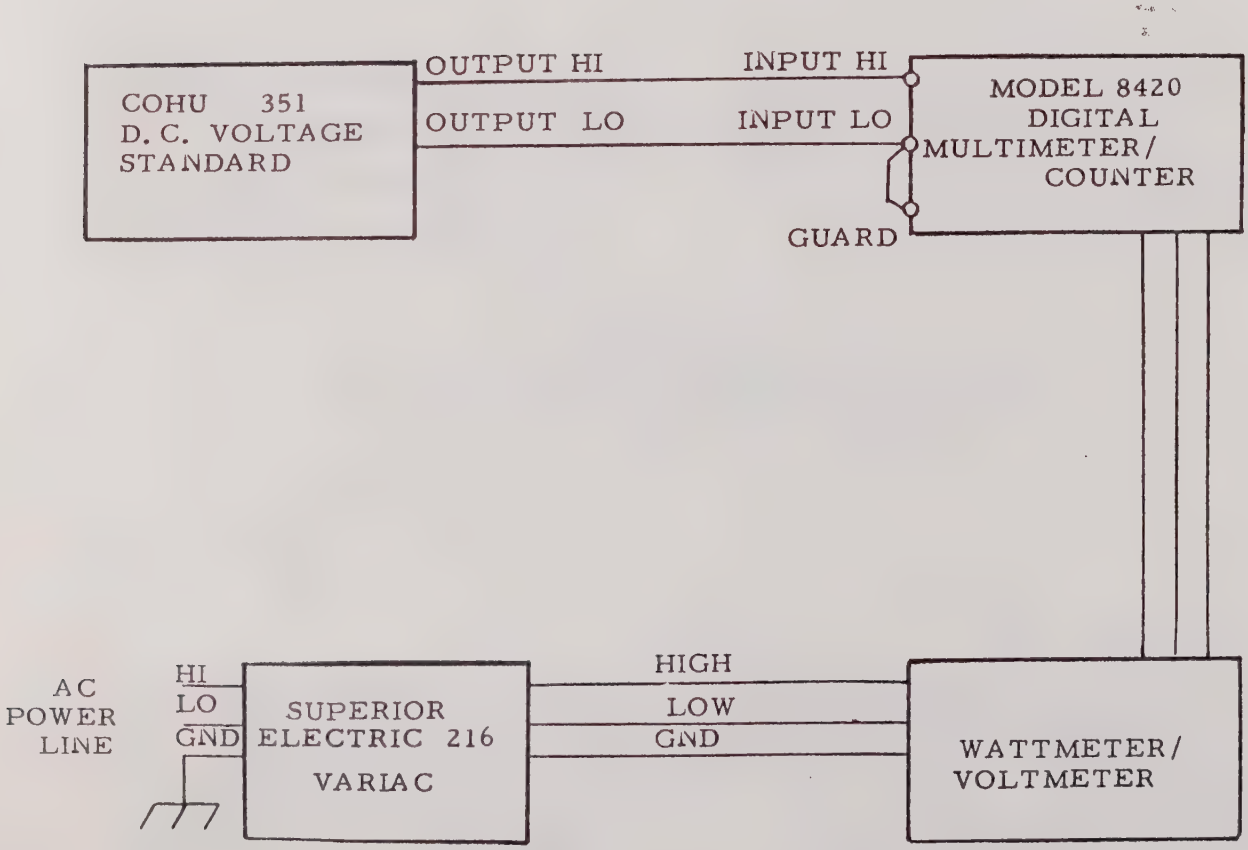


FIGURE 4-8
INPUT POWER AND LINE VOLTAGE VARIATION
TEST CIRCUIT

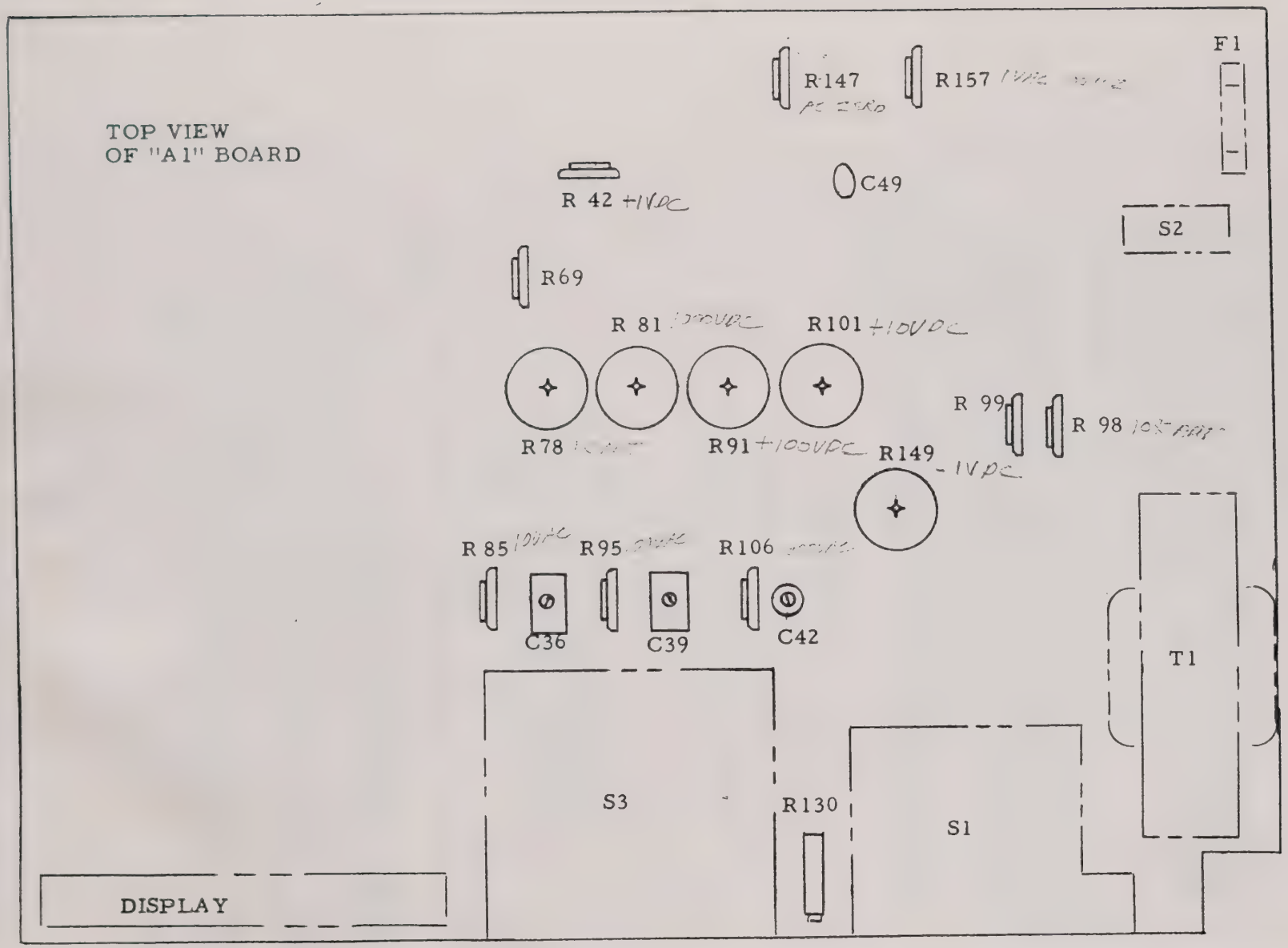


FIGURE 4-9 LOCATION OF ADJUSTMENTS FOR MODEL 8420 DIGITAL MULTIMETER/COUNTER

5.1 GENERAL MAINTENANCE

The CALICO 8420 Digital Multimeter/Counter is a solid state instrument designed to give years of trouble free service. Since the instrument has no moving parts, maintenance is limited to periodic cleaning in accordance with good commercial shop practices.

5.2 TROUBLESHOOTING

Experience has shown that often the difficulties encountered with equipment are poor input signals or misinterpretation of specifications. Check to be sure that the input is not noisy or erratic, and that characteristics of this instrument as defined in the specifications are fully understood.

Only skilled personnel who have studied the theory of operation section of this manual should attempt to repair the instrument.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety percautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections

The following is a guide to localizing the area of the malfunction.

1. Check the +15 volts DC power supply at the emitter of Q2. The +15 volts DC shuld be +15 volts DC ± 10% with less than 10 millivolts of ripple.
2. Check the -16 volts DC power supply at the emitter of Q3. The -16 volts DC should be -16 volts DC +10% -5% with less than 10 millivolts of ripple
3. Check the +5 volts DC power supply at pin 2 of IC19. The +5 volts DC power supply should be between 4.75 and 5.25 volts DC.
4. Check the supply voltage for the display tubes. This supply

should provide 180 volts rms ± 20% at the anode of CR1. The half wave rectified output shouls be at the cathode of CR1.

5. Check that the outputs of the precision reference amplifiers are + and - 6.2 volts DC ± 5%. The +6.2 volts DC output is located at CR11 cathode. The -6.2 volts DC output is located at CR15 anode. The ripple level at these outputs should not exceed 3 millivolts peak-to-peak
6. Check the input amplifier by applying an input of 1 volt DC to the input of the instrument on the 1 volt DC range. The preamplifier output, CR40 cathode, should be 6.2 volts DC ± 5%.
7. Check that the integrator output, which is the junction of R45 and R46, produces a ramping voltage with a slope proportional to the input voltage. Check that the integrator output does not clip on the peak of the triangle.
8. Check that the zero detector output, Q15 collector, changes state as the integrator output passes thru zero.
9. Check that the output of the 1MHz crystal oscillator, IC5 pin 8, is 1 MHz ± 0.05%.

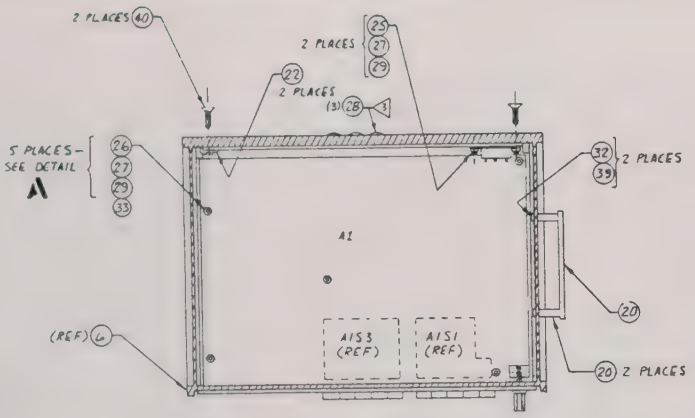
6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the 8420 Digital Multimeter/Counter

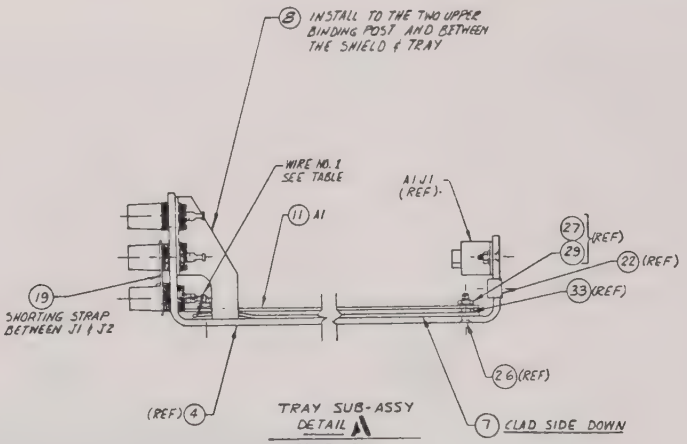
6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly designation for complete reference designation.

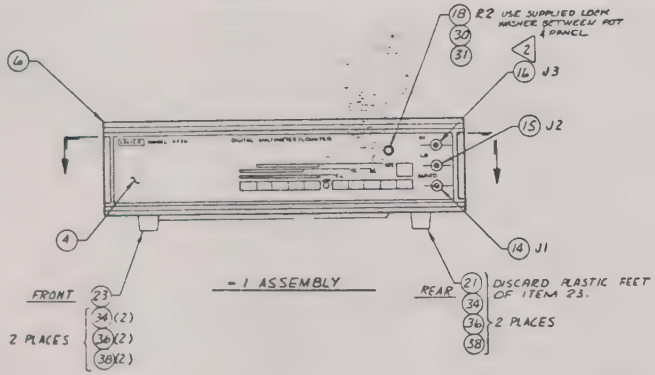
ASSEMBLY	COMPONENT	COMPLETE NUMBER
A1	R26	A1R26
A1	IC15	A1IC15
A1	Q4	A1Q4



- 1 ASSEMBLY
SECTION VIEW


(8) INSTALL TO THE TWO UPPER BINDING POST AND BETWEEN THE SHIELD & TRAY
WIRE NO. 1 SEE TABLE
(11) A1
A1J1 (REF).
(27) (29) (REF)
(22) (REF)
(33) (REF)
(19) SHORTING STRAP BETWEEN J1 & J2
(REF) (4)
(26) (REF)
(7) CLAD SIDE DOWN

TRAY SUB-ASSY
DETAIL A
SCALE: FULL
VIEWED FROM SIDE


(18) (30) (31) R2 USE SUPPLIED LOCK WASHER BETWEEN POT & PANEL.
(2) (16) J3
(15) J2
(6)
(4)
(14) J1
FRONT (23)
2 PLACES (34)(2) (36)(2) (38)(2)
REAR (21) DISCARDED PLASTIC FEET OF ITEM 23.
(34) (36) 2 PLACES (38)

- 1 ASSEMBLY

REAR VIEW OF R2
NO SCALE

WIRE TABLE

WIRE NO.	FROM	TO	AWG	COLOR	REMARKS
1	SHIELD (ITEM 7)	J1	100Ω RESISTOR		R1 ITEM 17
2	A1-10	J2	20	BLK	EXISTING A1 WIRE
3	A1-9	J3	20	RED	EXISTING A1 WIRE
4	R2-2	A1-7	COAX	RG174/U	SHIELD TIES TO R2-1 AND A1-6
5	R2-3	A1-12	COAX	RG174/U	SHIELD TIES TO R2-1 AND A1-6

ASSEMBLY SEQUENCE (REF)

CASE SUB-ASSY

1. ASSEMBLE ITEM 18 (BAIL) TO ITEM 6 (ENCLOSURE).
2. ASSEMBLE ITEM 5 HANDLE TO ITEM 6 (ENCLOSURE).

TRAY SUB-ASSY (DETAIL "A")

1. TIE "WIRE #1" (RESISTOR) TO ITEM 7 (SHIELD) THRU HOLE.
2. INSTALL ITEM 22 NUT-CLIPS TO ITEM 4 (TRAY)
3. ASSEMBLE ITEM 7 (SHIELD) TO ITEM 4 (TRAY) AS SHOWN IN DETAIL "A" (CLAD SIDE DOWN).
4. ASSEMBLE ITEM 11 (A1) TO TRAY-SHIELD ASSEMBLY.
5. ASSEMBLE ITEMS 14, 15, & 16 (BINDING POSTS) A1J1 & R2 TO ITEM 4 (TRAY).
6. TIE WIRES #2 & #3 TO BINDING POSTS
7. WIRE PER TABLE

SLIDE TRAY SUB-ASSY INTO CASE SUB-ASSY
↓
ASSEMBLE WITH ITEM 40

(3) SPREAD PRONGS ON HOLE PLUGS (ITEM 28) BEFOR INSTALLATION, FOR PROPER FIT.

(2) WIRE HOLES IN J1, J2, & J3 TO BE PARALLEL WITH TOP OF UNIT.

1 FOR UNIT SCHEMATIC, SEE DWG E8420-070.

NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPD

8420-400-1 PARTS LIST SEE SHEETS 3 & 4

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE

REQD PER ASSY -1

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE D

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TITLE: UNIT ASSEMBLY, DIGITAL MULTIMETER/COUNTER

MODEL 8420

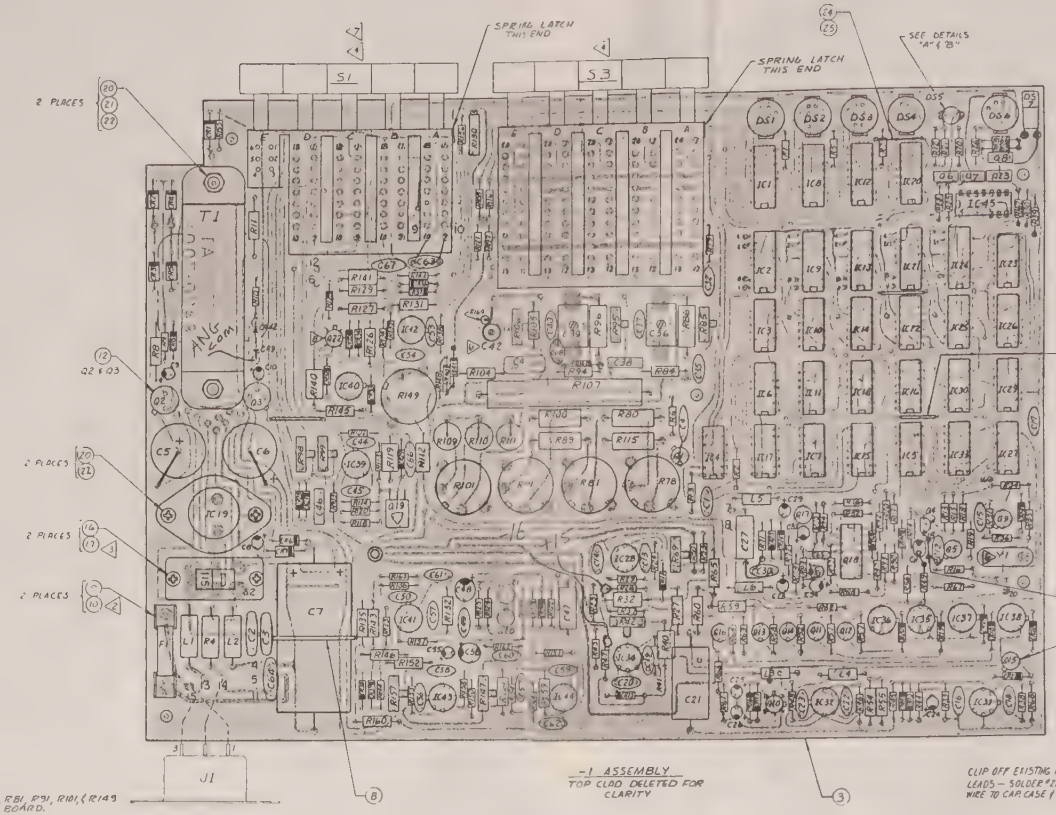
RELEASE
CHECKED
DESIGN
DRAFTSMAN

PURCHASING
PROJ ENGR
CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO. D8420-400
REV E
SCALE NONE SHEET 2 OF 4

DRAW QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH



-1 ASSEMBLY
TOP CLAD DELETED FOR CLARITY

DETAIL "C"
C42 ASSEMBLY TO PC BD

REAR VIEW OF J1

WIRE TABLE

WIRE NO	FROM	TO	WIRE TYPE	LENGTH AWG	REMARKS
1 THRU 11	SEE NOTE 5				
12	J1-1	A1-5	#20 AWG BLK	2.5 INCHES	
14	J1-2	A1-4	#20 AWG BLK	2.5 INCHES	I & E TOGETHER
15	J1-3	A1-3	#20 AWG RED	2.5 INCHES	I & E TOGETHER
16	A1-5 (OUT SIDE)	SEE 5	#24 AWG	7.0 INCHES	TIE E & I AND SHRINK TO A 1/4" DIAMETER
17	A1-4 (CLEAR)	SEE 4	2 CONDUCTOR SHIELD		SHRINK AND SECURE PIGTAILS
18					
19	A1-10	—	#20 AWG BLK	7.0 INCHES	I & E TOGETHER
20	A1-9	—	#20 AWG RED	7.0 INCHES	

REAR VIEW OF J1

1. MOUNT R78, R81, R91, R101, & R149 1/8 TO .175 P.C. BOARD.
2. DOT EXISTS ON CASE OF Q22, MOUNT WITH DOT TOWARDS SWITCHES.
3. PRIOR TO INSTALLATION - CUT OFF S1-E LEADS FLUSH WITH SWITCH CASE FAR SIDE ONLY
4. C42 & Y1 CAN NOT EXTEND MORE THAN 1/16 THRU P.C. BOARD. SEE DETAIL "C" FOR C42 INSTALLATION.
5. "I" TRANSFORMER WIRES TIE TO CORRESPONDING COLOR CODED POINTS ON P.C. BOARD. (I.E. T1-YEL WIRE TIES TO "YEL" TIE POINT ON P.C. BOARD, ETC.)
6. MOUNT PUSHBUTTON SWITCHES S1 & S3 .062 OFF BOARD, WITH LATCHING SPRINGS LOCATED AS SHOWN.
7. SOLDER SLIDE SWITCH TO BOARD WITH "115" ORIENTED AS SHOWN.
8. RIVET FUSE CLIPS TO BOARD WITH RIVET HEAD ON COMPONENT SIDE OF BOARD.

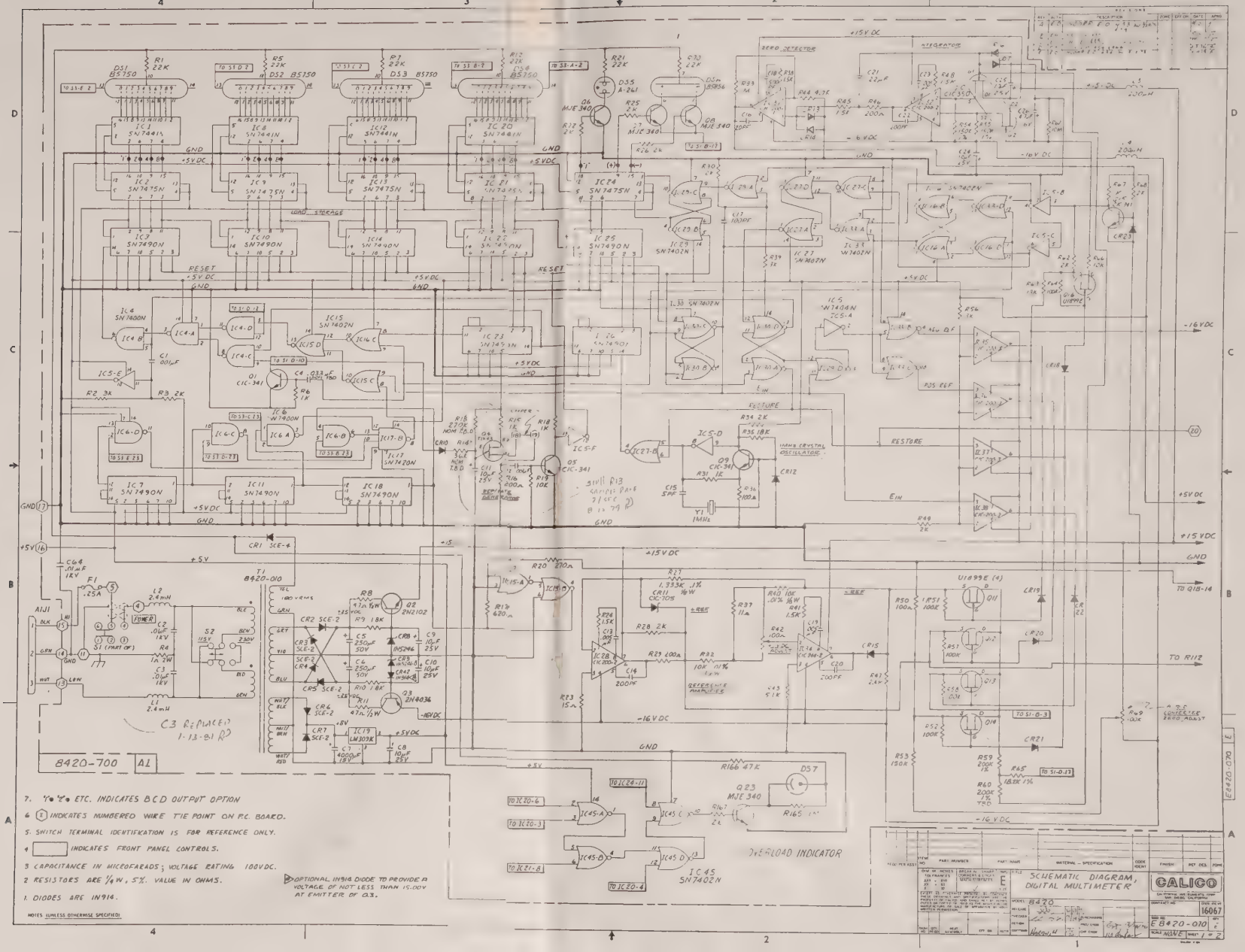
1 FOR P.C. BOARD SCHEMATIC DIAGRAM, SEE DWG NO. E4820-070.

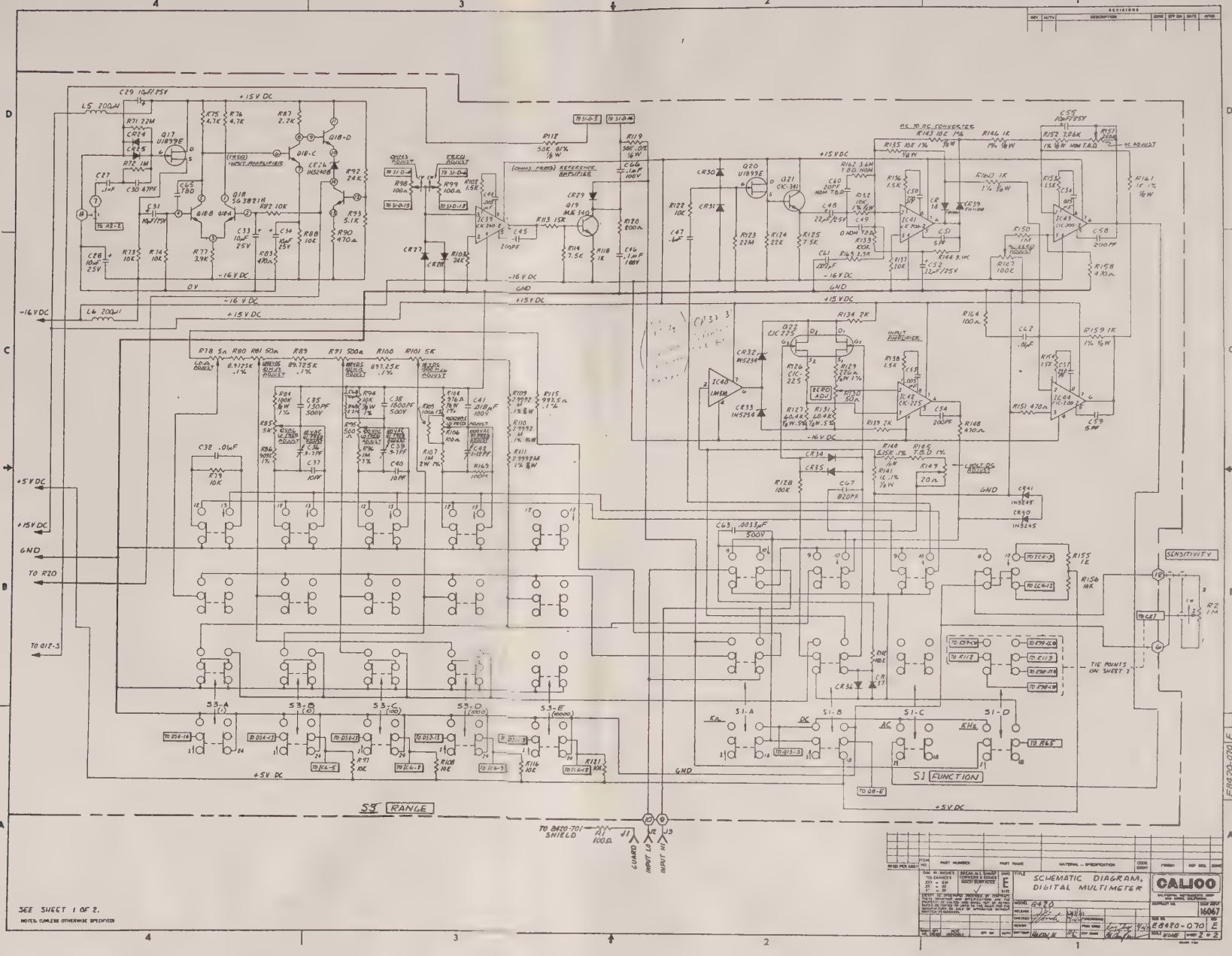
NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS					
REV	AUTH	DESCRIPTION	DONE	QTY QN	DATE

4420-100-1	PARTS LIST	SEE SHEETS 4 THRU 15			
PER NUMBER	PART NAME	MATERIAL SPECIFICATION	CODE IDENT	FINISH	REF DES

CALICO
TITLE: DC VOLTAGE/CURRENT METER
MODEL 8420
DWG NO. E8420-700
SIZE E
SHEET 2 OF 15


8420-700 AL
7. 'Y' 'Z' ETC. INDICATES BCD OUTPUT OPTION
6. ⑤ INDICATES NUMBERED WIRE TIE POINT ON P.C. BOARD.
5. SWITCH TERMINAL IDENTIFICATION IS FOR REFERENCE ONLY.
4. ▭ INDICATES FRONT PANEL CONTROLS.
3. CAPACITANCE IN MICROFARADS; VOLTAGE RATING 100VDC.
2. RESISTORS ARE 1/4 W, 5%. VALUE IN OHMS.
1. DIODES ARE IN914.
NOTES (UNLESS OTHERWISE SPECIFIED)
OPTIONAL IN914 DIODE TO PROVIDE A VOLTAGE OF NOT LESS THAN 15.00V AT EMITTER OF Q3.
C3 REPLACED 1-13-81 RD
SCHEMATIC DIAGRAM, DIGITAL MULTIMETER
CALICO
MODEL 8420
E 8420-010
16067
OVERLOAD INDICATOR
ZERO DETECTOR
INTEGRATOR
RESTORE
REFERENCE AMPLIFIER
A TO D CONVERTER ZERO ADJUST
+15V DC
-16V DC
+5V DC
GND


SCHEMATIC DIAGRAM, DIGITAL MULTIMETER
CALIOO
6420
E6420-070
SHEET 2 OF 2
SEE SHEET 1 OF 2.
NOTED FUNLESS OTHERWISE SPECIFIED
S3 RANGE
S1 FUNCTION
SENSITIVITY
TIE POINTS ON SHEET 1
+15V DC
-16V DC
+5V DC
GND
OV
TO R20
TO 012-3
TO 8420-701 SHIELD
GUARD
INPUT LO
INPUT HI
DC TO DC CONVERTER
REFERENCE AMPLIFIER
INPUT AMPLIFIER
INPUT PREAMPLIFIER
ZERO ADJUST
DC ADJUST
OHMS ADJUST
ZERO ADJ
LOW POWER OHMS ADJUST
HIGH POWER OHMS ADJUST
LOW OHMS ADJUST
HIGH OHMS ADJUST
LOADING ADJUST
LINEARITY ADJUST
SHUNT ADJUST
FREQ ADJUST
CAL ADJUST
SHUNT
SERIES
DIVIDER
DIVIDER & EXCESS
BINARY CODED DECIMAL
DATE
APPROVED
DRAWN
CHECKED
DESIGN
ENGINEER
MFG. APPROVAL
QUALITY APPROVAL
SHEET 2 OF 2

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alpha-numerical order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and CALIFORNIA INSTRUMENTS stock numbers are indicated.

7.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument,

b) CALIFORNIA INSTRUMENTS part number of the sub-assembly where component is located,

c) Component reference designator,

d) Component description,

e) Component manufacturer's number and code ident,

f) CALIFORNIA INSTRUMENTS stock number.

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, a division of Aiken Industries, San Diego, California, 92111.

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	8420-400-1	MULTIMETER ASSY	16067		1
					2
					3
	D8420-200-1	TRAY, FRONT PANEL	16067	2-10350	4
					5
	D8420-207-1	ENCLOSURE ASSY	16067	1-10263	6
	C8420-701-7	SHIELD	16067	1-60127	7
	C8420-209-7	BRACKET	16067	1-10270	8
					9
					10
A1	E8420-700-1	P. C. BOARD ASSY	16067		11
					12
					13
J1	1517-BLK	BINDING POST, BLACK	83330	2-50147	14
J2	1517-WHT	BINDING POST, WHITE	83330	2-50148	15
J3	1517-RED	BINDING POST, RED	83330	2-50149	16
R1	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	17
R2	B8420-013-1	POTENTIOMETER 1MΩ	16067	5-70169	18
	327	SHORTING STRAP	83330	2-50159	19
	13754-A-1032-1B	HANDLE	06540	2-10356	20
	2091	RUBBER FOOT	08065	2-10146	21
	A4972-4A-82	NUT-CLIP, FLOATING	22599	2-10353	22
	10" BAIL SET	BAIL	21604	2-10351	23
	17258	POWER CORD	70903	2-41094	24
	4-40 UNCx 5/16 Lg	SCREW, FLAT HD. 100°			25
	4-40 UNCx 1/2 Lg.	SCREW, FLAT HD. 100°			26
	4-40 UNCx3/16Hex	MACHINE NUT			27
	653	HOLE PLUG	83330		28
	#4	LOCKWASHER, INT STAR			29
	020-122	KNOB	0000K	2-10386	30
	040-102	KNOB CAP	0000K	2-10387	31
	10-32 UNC x 3/8 Lg	SCREW, PAN HD.			32
	N4-40-X	NUT NYLON	95987	2-10136	33
	6-32 UNC x 5/8 Lg	SCREW, PAN HD.			34
					35
	6-32 UNC x 1/4 Hex	MACHINE NUT			36

MODEL	8420	CALICO P/N	8420-400	E	ASSY R.D.
TITLE	DIGITAL MULTIMETER/COUNTER ASSEMBLY		SHT 3 OF 4		

CALICO

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
					37
	#6	LOCKWASHER, INT STAR			38
	#10	LOCKWASHER, INT STAR			39
	8-32 UNC x 7/8Lg	SCREW, FLAT HD, 100°			40

MODEL 8420 | CALICO P/N 8420-400 | ASSY R.D.

TITL. DIGITAL MULTIMETER/COUNTER ASSEMBLY | SHT 4 OF 4

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	8420-700-1	P. C. BOARD ASSY	16067		1
					2
	8420-700-7	P. C. BOARD	16067	1-60126	3
	1530B-1/4	STANDOFF	88245	2-10303	4
SEE	9536B-A-0440	STANDOFF	06540	2-10349	5
SHEET 3	1299B-1	TERMINAL	88245	2-50146	6
	2010B-1	TERMINAL	88245	2-50076	7
	2829-115-3	MOUSETAIL	98159	2-10151	8
	121002	FUSEHOLDER	75915	2-40262	9
	1236	RIVET	73734	2-10166	10
	8420-100	SOLDER MASK	16067		11
	RCT05075-7A	TRANSIPAD, TO-5	19080	2-40296	12
	RCT018110-1A	TRANSIPAD, TO-18	19080	2-40297	13
	8762	WIRE, SHIELDED, 2-COND	70903		14
					15
	4-40 UNC x 1/4 LG.	SCREW, PAN HEAD			16
	#4	LOCKWASHER, INT STAR			17
					18
					19
	6-32 UNC x 5/16 LG	SCREW, PAN HEAD			20
	6-32 UNC	HEX MACHINE NUT			21
	#6	LOCKWASHER, INT STAR			22
					23
	#24 AWG	BUSS WIRE			24
	#24 AWG	TEFLON SLEEVING			25
	RG 174/U	CABLE, COAX	81349		26
	8420-100	DECAL, NEON	16067	2-10355	27
A1C1	5HK-D10	CAPACITOR .001μf/1KV	56289	6-10062	28
A1C2	5HK-S10	CAPACITOR .01μf/1KV	56289	6-10768	29
A1C3	5HK-S10	CAPACITOR .01μf/1KV	56289	6-10768	30
A1C4	225P33391	CAPACITOR .033μf/100V	56289	6-10732	31
A1C5	39D257G050HE4	CAPACITOR 250μf/50V	56289	6-10495	32
A1C6	39D257G050HE4	CAPACITOR 250μf/50V	56289	6-10495	33
A1C7	39D408G015JL4	CAPACITOR 4000μf/15V	56289	6-10631	34
A1C8	T360B106M025AS	CAPACITOR 10μf/25V	05397	6-10738	35
A1C9	T360B106M025AS	CAPACITOR 10μf/25V	05397	6-10738	36

MODEL	CALICO P/N		ASSY R.D.
8420	8420-700	E	
TITLE		SHT 1 OF 15	
P. C. BOARD ASSY, DIGITAL MULTIMETER			A1

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1C10	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	37
A1C11	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	38
A1C12	5HK-D10	CAPACITOR .001µf/1KV	56289	6-10062	39
A1C13	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	40
A1C14	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	41
A1C15	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	42
A1C16	CM05E200J03	CAPACITOR 20pf/500V	81349	6-10008	43
A1C17	CM05FD101J03	CAPACITOR 100pf/500V	81349	6-10027	44
A1C18	DM-15-501J	CAPACITOR 500pf/500V	72136	6-10649	45
A1C19	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	46
A1C20	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	47
A1C21	PA2A224	CAPACITOR .22µf/50V	27556	6-10772	48
A1C22	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	49
A1C23	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	50
A1C24	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	51
A1C25	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	52
A1C26	T360B476M006AS	CAPACITOR 47µf/6V	05397	6-10775	53
A1C27	225P10491	CAPACITOR .1µf/100V	56289	6-10720	54
A1C28	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	55
A1C29	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	56
A1C30	CM05E470J03	CAPACITOR 47pf/500V	81349	6-10268	57
A1C31	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	58
A1C32	TG-S10	CAPACITOR .01µf/100V	56289	6-10759	59
A1C33	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	60
A1C34	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	61
A1C35	CM05FD131J03	CAPACITOR 130pf/500V	81349	6-10278	62
A1C36	400	CAPACITOR, Variable .9-7pf	72136	6-10762	63
A1C37	CM05CD100J03	CAPACITOR 10pf/500V	81349	6-10004	64
A1C38	CM06F182J03	CAPACITOR 1800pf/500V	81349	6-10054	65
A1C39	400	CAPACITOR, Variable .9-7pf	72136	6-10762	66
A1C40	CM05CD100J03	CAPACITOR 10pf/500V	81349	6-10004	67
A1C41	1MD-1-183J	CAPACITOR .018µF/100V	72136	6-10774	68
A1C42	VC58G	CAPACITOR, Variable 1-12pf	73899	6-10458	69
A1C43	NOT USED				70
A1C44	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	71
A1C45	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	72

MODEL 8420 — CALICO P/N 8420-700 E — ASSY R.D. A1

TITLE P. C. BOARD ASSY, DIGITAL MULTIMETER — SHT 5 OF 15

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1C46	TG-P10	CAPACITOR .1pf/100V	56289	6-10127	73
A1C47	225P10491	CAPACITOR .1µf/100V	56289	6-10720	74
A1C48	T360C226M025AS	CAPACITOR 22µf/25V	05397	6-10746	75
A1C49	CM05	CAPACITOR T.B.D.			76
A1C50	CM05FD221J03	CAPACITOR 220pf/500V	81349	6-10036	77
A1C51	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	78
A1C52	T360C226M025AS	CAPACITOR 22µf/25V	05397	6-10746	79
A1C53	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	80
A1C54	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	81
A1C55	T360B106M025AS	CAPACITOR 10µf/25V	05397	6-10738	82
A1C56	TG-D50	CAPACITOR .005µf/100V	56289	6-10770	83
A1C57	CM05FD221J03	CAPACITOR 220pf/500V	81349	6-10036	84
A1C58	CM05FD201J03	CAPACITOR 200pf/500V	81349	6-10282	85
A1C59	CM05CD050D03	CAPACITOR 5pf/500V	81349	6-10483	86
A1C60	CM05ED200J03	CAPACITOR 20pf/500V	81349	6-10008	87
A1C61	5GA-D20	CAPACITOR .002µf/1KV	56289	6-10055	88
A1C62	TG-S10	CAPACITOR .01µf/100V	56289	6-10759	89
A1C63	CM06FD332J03	CAPACITOR .0033µf/500V	81349	6-10779	90
A1C64	5HK-S10	CAPACITOR .01µf/1KV	56289	6-10768	91
A1C65	CM05 TBD	CAPACITOR TBD			92
A1C66	TG-P10	CAPACITOR .1µf/100V	56289	6-10127	93
A1C67	CM05F821J03	CAPACITOR 820pf/500V	81349	6-10050	94
A1C68	CM05C100J03	CAPACITOR 10pf	81349	6-10004	95
					96
					97
					98
A1CR1	SCE-4	DIODE	14099	3-10084	99
A1CR2	THRU A1CR7:				100
	SCE-2	DIODE	14099	3-10079	101
A1CR8	IN5246	DIODE, ZENER	04713	3-10068	102
A1CR9	IN5246B	DIODE, ZENER	04713	3-10173	103
A1CR10	IN914	DIODE	15818	3-10118	104
A1CR11	C1C 705	DIODE, ZENER	16067	3-10197	105
A1CR12	IN914	DIODE	15818	3-10118	106
A1CR13	IN914	DIODE	15818	3-10118	107
A1CR14	IN914	DIODE	15818	3-10118	108

MODEL	8420	CALICO P/N	8420-700	E	ASSY R.D.
TITLE	P.C. BOARD ASSY, DIGITAL MULTIMETER	SHT 6 OF 15			A1

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1CR15	IN914	DIODE	15818	3-10118	109
A1CR16	IN914	DIODE	15818	3-10118	110
A1CR17	IN914	DIODE	15818	3-10118	111
A1CR18	IN914	DIODE	15818	3-10118	112
A1CR19	IN914	DIODE	15818	3-10118	113
A1CR20	IN914	DIODE	15818	3-10118	114
A1CR21	IN914	DIODE	15818	3-10118	115
A1CR22	IN914	DIODE	15818	3-10118	116
A1CR23	IN914	DIODE	15818	3-10118	117
A1CR24	IN914	DIODE	15818	3-10118	118
A1CR25	IN914	DIODE	15818	3-10118	119
A1CR26	IN5240 B	DIODE, ZENER	04713	3-10169	120
A1CR27	IN914	DIODE	15818	3-10118	121
A1CR28	IN914	DIODE	15818	3-10118	122
A1CR29	IN914	DIODE	15818	3-10118	123
A1CR30	IN914	DIODE	15818	3-10118	124
A1CR31	IN914	DIODE	15818	3-10118	125
A1CR32	IN5234	DIODE, ZENER	04713	3-10204	126
A1CR33	IN5234	DIODE, ZENER	04713	3-10204	127
A1CR34	IN914	DIODE	15818	3-10118	128
A1CR35	IN914	DIODE	15818	3-10118	129
A1CR36	IN914	DIODE	15818	3-10118	130
A1CR37	IN914	DIODE	15818	3-10118	131
A1CR38	FH1100	DIODE	02335	3-10212	132
A1CR39	FH1100	DIODE	02335	3-10212	133
A1CR40	IN5245	DIODE, ZENER	04713	3-10067	134
A1CR41	IN5245	DIODE, ZENER	04713	3-10067	135
A1CR42	IN914	DIODE	15818	3-10118	136
					137
					138
					139
A1DS1	B5750	DISPLAY TUBE	83594	2-30031	140
A1DS2	B5750	DISPLAY TUBE	83594	2-30031	141
A1DS3	B5750	DISPLAY TUBE	83594	2-30031	142
A1DS4	B5750	DISPLAY TUBE	83594	2-30031	143
A1DS5	A-261	DISPLAY TUBE, NEON	74276	2-41081	144

MODEL		CALICO P/N		ASSY R.D.
	8420		8420-700 E	
TITLE	P. C. BOARD ASSY, DIGITAL MULTIMETER	SHT 7	OF 15	A1

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067 — **PARTS LIST**

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1DS6	B5856	DISPLAY TUBE, POL	83594	2-30036	145
A1DS7	99-33081-6P46-020	INDICATOR LAMP	87034	2-50160	146
					147
					148
					149
A1F1	313.250	FUSE, .25A, SLO-BLO	75915	2-40258	150
230 Only	MDL-1/8A	FUSE 1/8A SLO-BLO	71400	2-70024	151
					152
					153
					154
A1IC1	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	155
A1IC2	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	156
A1IC3	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	157
A1IC4	SN7400N	INTEGRATED CIRCUIT	27014	3-60000	158
A1IC5	SN7404N	INTEGRATED CIRCUIT	27014	3-60002	159
A1IC6	SN7400N	INTEGRATED CIRCUIT	27014	3-60000	160
A1IC7	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	161
A1IC8	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	162
A1IC9	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	163
A1IC10	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	164
A1IC11	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	165
A1IC12	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	166
A1IC13	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	167
A1IC14	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	168
A1IC15	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	169
A1IC16	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	170
A1IC17	SN7420N	INTEGRATED CIRCUIT	27014	3-60012	171
A1IC18	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	172
A1IC19	LM309K	INTEGRATED CIRCUIT	27014	3-60007	173
A1IC20	SN7441N	INTEGRATED CIRCUIT	27014	3-60003	174
A1IC21	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	175
A1IC22	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	176
A1IC23	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	177
A1IC24	SN7475N	INTEGRATED CIRCUIT	27014	3-60004	178
A1IC25	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	179
A1IC26	SN7490N	INTEGRATED CIRCUIT	27014	3-60005	180

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1IC27	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	181
A1IC28	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	182
A1IC29	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	183
A1IC30	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	184
A1IC31	CIC-200-1	INTEGRATED CIRCUIT	16067	3-30134	185
A1IC32	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	186
A1IC33	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	187
A1IC34	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	188
A1IC35	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	189
A1IC36	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	190
A1IC37	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	191
A1IC38	CIC-200-3	INTEGRATED CIRCUIT	16067	3-60006	192
A1IC39	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	193
A1IC40	LM310	INTEGRATED CIRCUIT	27014	3-60011	194
A1IC41	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	195
A1IC42	CIC-225	INTEGRATED CIRCUIT	16067	3-60008	196
A1IC43	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	197
A1IC44	CIC-200-2	INTEGRATED CIRCUIT	16067	3-30006	198
A1IC45	SN7402N	INTEGRATED CIRCUIT	27014	3-60001	199
					200
					201
					202
					203
A1J1	AC3	CONN. RECEPTACLE	82389	4-10111	204
					205
					206
					207
					208
A1L1	2500-46	CHOKE 2.4mH	99800	5-90048	209
A1L2	2500-46	CHOKE 2.4mH	99800	5-90048	210
A1L3	1537-90	CHOKE 200μH	99800	5-90005	211
A1L4	1537-90	CHOKE 200μH	99800	5-90005	212
A1L5	1537-90	CHOKE 200μH	99800	5-90005	213
A1L6	1537-90	CHOKE 200μH	99800	5-90005	214
					215
					216

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
					217
					218
					219
A1Q1	CIC-341	TRANSISTOR	16067	3-30184	220
A1Q2	2N2102	TRANSISTOR	95303	3-30075	221
A1Q3	2N4036	TRANSISTOR	95303	3-30106	222
A1Q4	TIS43	TRANSISTOR	01295	3-30131	223
A1Q5	CIC-341	TRANSISTOR	16067	3-30184	224
A1Q6	MJE 340	TRANSISTOR	04713	3-30199	225
A1Q7	MJE 340	TRANSISTOR	04713	3-30199	226
A1Q8	MJE 340	TRANSISTOR	04713	3-30199	227
A1Q9	CIC-341	TRANSISTOR	16067	3-30184	228
A1Q10	CIC-350	TRANSISTOR, FET, DUAL	16067	3-30016	229
A1Q11	U1899E	TRANSISTOR, FET	15818	3-30196	230
A1Q12	U1899E	TRANSISTOR, FET	15818	3-30196	231
A1Q13	U1899E	TRANSISTOR, FET	15818	3-30196	232
A1Q14	U1899E	TRANSISTOR, FET	15818	3-30196	233
A1Q15	CIC-341	TRANSISTOR	16067	3-30184	234
A1Q16	U1899E	TRANSISTOR, FET	15818	3-30196	235
A1Q17	U1899E	TRANSISTOR, FET	15818	3-30196	236
A1Q18	SG 3821 N	TRANSISTOR, ARRAY	0000J	3-30203	237
A1Q19	MJE 340	TRANSISTOR	04713	3-30199	238
A1Q20	U1899E	TRANSISTOR, FET	15818	3-30196	239
A1Q21	CIC-341	TRANSISTOR	16067	3-30184	240
A1Q22	CIC-225	SEE ITEM 196			241
A1Q23	MJE 340	TRANSISTOR	04713	3-30199	242
					243
					244
					245
A1R1	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	246
A1R2	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	247
A1R3	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	248
A1R4	BWH 1Ω 5% 2W	RESISTOR 1Ω 2W 5%	07716	5-40001	249
A1R5	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	250
A1R6	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	251
A1R7	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	252

MODEL	CALICO P/N		SHT	OF	ASSY R.D.
8420	8420-700	E	10	15	A1

TITLE: P. C. BOARD ASSY, DIGITAL MULTIMETER

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R8	RC20GF470J	RESISTOR 47Ω 1/2W 5%	81349	5-20013	253
A1R9	RC07GF182J	RESISTOR 1.8K 1/4W 5%	81349	5-10058	254
A1R10	RC07GF182J	RESISTOR 1.8K 1/4W 5%	81349	5-10058	255
A1R11	RC20GF470J	RESISTOR 47Ω 1/2W 5%	81349	5-20013	256
A1R12	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	257
A1R13	RC07GF274J	RESISTOR 270K 1/4W 5%	81349	5-10110	258
A1R14	RC07GF363J	RESISTOR 36K 1/4W 5%	81349	5-10089	259
A1R15	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	260
A1R16	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	261
A1R17	RC07GF620J	RESISTOR 620Ω 1/4W 5%	81349	5-10048	262
A1R18	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	263
A1R19	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	264
A1R20	RC07GF271J	RESISTOR 270Ω 1/4W 5%	81349	5-10039	265
A1R21	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	266
A1R22	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	267
A1R23	RC07GF150J	RESISTOR 15Ω 1/4W 5%	81349	5-10009	268
A1R24	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	269
A1R25	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	270
A1R26	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	271
A1R27	MK-14	RESISTOR 1.333K 1/8W .1%	17838	5-80158	272
A1R28	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	273
A1R29	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	274
A1R30	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	275
A1R31	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	276
A1R32	MK-14	RESISTOR 10.000K 1/8W .01%	17838	5-80148	277
A1R33	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	278
A1R34	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	279
A1R35	RC07GF183J	RESISTOR 18K 1/4W 5%	81349	5-10082	280
A1R36	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	281
A1R37	RC07GF110J	RESISTOR 11Ω 1/4W 5%	81349	5-10006	282
A1R38	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	283
A1R39	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	284
A1R40	MK-14	RESISTOR 10K 1/8W .01%	17838	5-80148	285
A1R41	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	286
A1R42	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	287
A1R43	RC07GF512J	RESISTOR 5.1K 1/4W 5%	81349	5-10069	288

MODEL 8420 — CALICO P/N 8420-700 — A — ASSY R.D. A1

TITLE P.C. BOARD ASSY, DIGITAL MULTIMETER

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R44	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	289
A1R45	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	290
A1R46	RC07GF201J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	291
A1R47	RC07GF242J	RESISTOR 2.4K 1/4W 5%	81349	5-10061	292
A1R48	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	293
A1R49	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	294
A1R50	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	295
A1R51	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	296
A1R52	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	297
A1R53	RC07GF154J	RESISTOR 150K 1/4W 5%	81349	5-10104	298
A1R54	RN60D1503F	RESISTOR 150K 1/4W 1%	81349	5-60446	299
A1R55	RN60D1503F	RESISTOR 150K 1/4W 1%	81349	5-60446	300
A1R56	RC07GF302J	RESISTOR 3K 1/4W 5%	81349	5-10063	301
A1R57	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	302
A1R58	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	303
A1R59	RN60D2003F	RESISTOR 200K 1/4W 1%	81349	5-60147	304
A1R60	RN60D2003F	RESISTOR 200K 1/4W 1%	81349	5-60147	305
A1R61	RC07GF106J	RESISTOR 10M 1/4W 5%	81349	5-10135	306
A1R62	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	307
A1R63	RC07GF133J	RESISTOR 13K 1/4W5%	81349	5-10079	308
A1R64	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	309
A1R65	RN60D1822F	RESISTOR 18.2K 1/4W 1%	81349	5-60097	310
A1R66	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	311
A1R67	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	312
A1R68	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	313
A1R69	X-201R104	POTENTIOMETER 100K	71450	5-70157	314
A1R70	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	315
A1R71	RC07GF226J	RESISTOR 22M 1/4W 5%	81349	5-10139	316
A1R72	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	317
A1R73	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	318
A1R74	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	319
A1R75	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	320
A1R76	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	321
A1R77	RC07GF392J	RESISTOR 3.9K 1/4W 5%	81349	5-10066	322
A1R78	U39-5Ω	POTENTIOMETER 5Ω	12697	5-70158	323
A1R79	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	324

MODEL 8420 — CALICO P/N 8420-700 D — ASSY R.D. A1

TITLE P.C. BOARD ASSY, DIGITAL MULTIMETER — SHT 12 OF 15

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R80	MK-3H	RESISTOR 8.9725K 1/4W .1%	17838	5-80159	325
A1R81	U39-50Ω	POTENTIOMETER 50Ω	12697	5-70160	326
A1R82	RC07GF103J	RESISTOR 10K 1/4 W 5%	81349	5-10076	327
A1R83	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	328
A1R84	RN60C1003F	RESISTOR 100K 1/8W 1%	81349	5-60131	329
A1R85	X-201R502	POTENTIOMETER 5K	71450	5-70156	330
A1R86	RN65C9093F	RESISTOR 909K 1/4W 1%	81349	5-60447	331
A1R87	RC07GF222J	RESISTOR 2.2K 1/4W 5%	81349	5-10060	332
A1R88	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	333
A1R89	MK-3H	RESISTOR 89.725K 1/4W .1%	17838	5-80160	334
A1R90	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	335
A1R91	U39-500Ω	POTENTIOMETER 500Ω	12697	5-70161	336
A1R92	RC07GF243J	RESISTOR 24K 1/4W 5%	81349	5-10085	337
A1R93	RC07GF512J	RESISTOR 5.1K 1/4W 5%	81349	5-10069	338
A1R94	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	339
A1R95	X-201R501	POTENTIOMETER 500Ω	71450	5-70155	340
A1R96	RN65C1004F	RESISTOR 1M 1/4W 1%	81349	5-60178	341
A1R97	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	342
A1R98	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	343
A1R99	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	344
A1R100	MK-3H	RESISTOR 897.25K 1/4W .1%	17838	5-80161	345
A1R101	U39-5K	POTENTIOMETER 5K	12697	5-70162	346
A1R102	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	347
A1R103	RC07GF243J	RESISTOR 24K 1/4W 5%	81349	5-10085	348
A1R104	RN60C9760F	RESISTOR 976Ω 1/8W 1%	81349	5-60451	349
A1R105	RN60D1000F	RESISTOR 100Ω 1/4W 1%	81349	5-60005	350
A1R106	X-201R101	POTENTIOMETER 100Ω	71450	5-70153	351
A1R107	MF-2-1M-T-2-1%	RESISTOR 1M 2W 1%	91637	5-50191	352
A1R108	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	353
A1R109	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	354
A1R110	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	355
A1R111	MK-9H	RESISTOR 2.9992M 3/4W .1%	17838	5-80162	356
A1R112	MK-14	RESISTOR 50K 1/8W .01%	17838	5-80163	357
A1R113	RC07GF153J	RESISTOR 15K 1/4W 5%	81349	5-10080	358
A1R114	RC07GF752J	RESISTOR 7.5K 1/4W 5%	81349	5-10073	359
A1R115	MK-3H	RESISTOR 997.5Ω 1/4W .1%	17838	5-80164	360

MODEL 8420 — CALICO P/N 8420-700 E — ASSY R.D. A1

TITL: P.C. BOARD ASSY, DIGITAL MULTIMETER — SHT 14 OF 15

CALICO — CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R116	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	361
A1R117	NOT USED				362
A1R118	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	363
A1R119	MK-14	RESISTOR 50K 1/8W .01%	17838	5-80163	364
A1R120	RC07GF200J	RESISTOR 200Ω 1/4W 5%	81349	5-10036	365
A1R121	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	366
A1R122	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	367
A1R123	RC07GF226J	RESISTOR 22M 1/4W 5%	81349	5-10139	368
A1R124	RC07GF223J	RESISTOR 22K 1/4W 5%	81349	5-10084	369
A1R125	RC07GF752J	RESISTOR 7.5K 1/4W 5%	81349	5-10073	370
A1R126	CIC-225	SEE ITEM 196			371
A1R127	RN60C6042D	RESISTOR 60.4K 1/8W .5%	81349	5-60433	372
A1R128	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	373
A1R129	RN60C2260F	RESISTOR 226Ω 1/8W 1%	81349	5-60449	374
A1R130	ET34P-500	POTENTIOMETER 50Ω	30983	5-70130	375
A1R131	RN60C6042D	RESISTOR 60.4K 1/8W .5%	81349	5-60433	376
A1R132	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	377
A1R133	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	378
A1R134	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	379
A1R135	RN60C1002F	RESISTOR 10K 1/8W 1%	81349	5-60081	380
A1R136	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	381
A1R137	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	382
A1R138	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	383
A1R139	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	384
A1R140	MK-14	RESISTOR 5.15K 1/8W .1%	17838	5-80155	385
A1R141	MK-14	RESISTOR 1K 1/8W .1%	17838	5-80154	386
A1R142	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	387
A1R143	RN60C1002F	RESISTOR 10K 1/8W 1%	83149	5-60081	388
A1R144	RC07GF912J	RESISTOR 9.1K 1/4W 5%	81349	5-10075	389
A1R145	RN60D	RESISTOR T.B.D.	81349		390
A1R146	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	391
A1R147	X-201R104	POTENTIOMETER 100K	71450	5-70157	392
A1R148	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	393
A1R149	U39-20Ω	POTENTIOMETER 20Ω	12697	5-70159	394
A1R150	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	395
A1R151	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	396

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PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R152	RN60C7061F	RESISTOR 7.06K 1/8W 1%	81349	5-60537	397
A1R153	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	398
A1R154	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	399
A1R155	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	400
A1R156	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	401
A1R157	X-201R251	POTENTIOMETER, 250Ω	71450	5-70154	402
A1R158	RC07GF471J	RESISTOR 470Ω 1/4W 5%	81349	5-10045	403
A1R159	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	404
A1R160	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	405
A1R161	RN60C1001F	RESISTOR 1K 1/8W 1%	81349	5-60342	406
A1R162	RC07GF365J	RESISTOR 3.6M 1/4W 5%	81349	5-10140	407
A1R163	RC07GF392J	RESISTOR 3.9K 1/4W 5%	81349	5-10066	408
A1R164	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	409
A1R165	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	410
A1R166	RC07GF473J	RESISTOR 47K 1/4W 5%	81349	5-10092	411
A1R167	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	412
A1R168	RC07GF225J	RESISTOR 2.2M 1/4W 5%	81349	5-10126	413
A1R169	RC07GF107K	RESISTOR 100M 1/4W 10%	81349	5-10145	414
A1S1	8420-012-1	SWITCH, FUNCTION	16067	2-40430	415
A1S2	46206LF	SWITCH, VOLTAGE	82389	2-40298	416
A1S3	8420-011-1	SWITCH, RANGE	16067	2-40429	417
					418
					419
					420
					421
					422
A1T1	8420-010-1	TRANSFORMER	16067	7-10207	423
					424
					425
					426
					427
					428
A1Y1	CR-18A/U	CRYSTAL 1MHz	13454	3-30135	429
					430
					431
					432

MODEL 8420 — CALICO P/N 8420-700 E — ASSY R.D. A1

TITLE P.C. BOARD ASSY, DIGITAL MULTIMETER — SHT 15 OF 15

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, Pa.
0000B	Tech. Prod., Sales	Sorrento Valley, Ca.
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, Ill.
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, Ca.
0000G	Use Code #30983	
0000H	Mial Of Italy c/o Q. C. Components	Los Angeles, Ca.
0000I	Monsanto, Electronic Special Products	Cupertino, Ca.
0000J	Silicon General	Los Angeles, Ca.
0000K	Elma	Schweiz, Germany
0000L	Intersil	Cupertino, Ca.
0000M	Precision Dynamics Corp.	Burbank, Ca.
00141	Pic Design Corp.	E. Rockaway, N. Y.
00544	Metal-Cal Div, Avery Prod. Corp.	Inglewood, Ca.
00656	Aerovox Corporation	New Bedford, Mass.
00779	AMP, Inc.	Harrisburg, Pa.
00853	Sangamo Electric Company	Pickens, S. C.
00866	Goe Eng. Co., Inc.	City of Industry, Ca.
01121	Allen-Bradley Company	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Ca.
01281	T R W Semiconductors, Inc.	Lawndale, Ca.
01295	Texas Instruments, Inc.	Dallas, Tex.
02111	Spectrol Electronics	City of Industry, Ca.
02114	Ferroxcube Corp.	Saugerties, N. Y.
02335	Fairchild Controls Corp.	Hicksville, LI, N. Y.
02660	Amphenol Corporation	Broadview, Ill.
02799	Use Code #72136	
03507	General Electric Company	Syracuse, N. Y.
03508	General Electric Company	Syracuse, N. Y.
03516	General Electric Company	Somersworth, N. H.
03797	Eldema Corporation	Compton, Ca.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03911	Clairex Corporation	New York, N. Y.
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, Ct.
04062	Use Code #72136	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, Ariz.
04963	3-M	St. Paul, Minn.
05276	Pomona Electronics Co., Inc.	Pomona, Ca.
05397	Kemet, Union Carbide Corp.	Cleveland, Ohio
05820	Wakefield Engineering, Inc.	Wakefield, Mass.
06184	Conelco Components	San Bernadino, Ca.
06223	Kooltronic Fan Company	Princeton, N. J.
06229	Electrovert, Incorporated	Mt. Vernon, N. Y.
06514	Stantron, Wyco Metal Products	N. Hollywood, Ca.
06540	Amathom Elect. Hardward	New Rochelle, N. Y.
06682	Magnetic Shield Div.	Chicago, Ill.
07088	Kelvin Electric Company	Van Nuys, Ca.
07256	Silicon Transistor Corp.	Garden City, N. Y.
07263	Fairchild Camera and Instr. Corp.	Mt. View, Ca.
07387	Birtcher Corporation	Los Angeles, Ca.
07556	Unitrack, Calabro Plastics	Upper Darby, Pa.
07716	I R C, Incorporated	Burrington, Iowa
07910	Continental Devices	Hawthorne, Ca.
08065	Accurate Rubber and Plastics Co.	San Diego, Ca.
08261	Spectra Strip	Garden Grove, Ca.
08289	Blinn-Delbert Co., Inc.	Pomona, Ca.
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, N. J.
09026	Babcock Electronics Corp.	Costa Mesa, Ca.
09145	Atohm, Technical Industries, Inc.	Burbank, Ca.
09353	C and K Components, Inc.	Newton, Mass.
11432	Diamond Metal Sales	Gardena, Ca.
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, Ca.
12020	Ovenaire, Incorporated	Charlottesville, Va.
12143	Bendix Corporation	Santa Ana, Ca.
12405	Hysol Corporation	El Monte, Ca.
12406	Elpac, Incorporated	Fullerton, Ca.
12463	Omtronics Mfg., Incorporated	Omaha, Neb.
12697	Clarostat Mfg. Co., Incorporated	Dover, N. H.
13103	Thermalloy Company	Dallas, Tex.
13454	Texas Crystals	River Grove, Ill.
14099	Semtech Corporation	Newbury Park, Ca.
14655	Cornell-Dubilier Elect. Corp.	Newark, N. J.
14726	Hollingsworth Co.	Phoenixville, Pa.
14752	Electro Cube, Incorporated	San Gabriel, Ca.
15112	Electra Scientific Corporation	Fullerton, Ca.
15801	Fenwall Electronics	Framingham, Mass.
15818	Amelco, Teledyne, Incorporated	Mt. View, Ca.
15909	Use Code #17870	
15912	Digital Sensors, Incorporated	Los Angeles, Ca.
16067	California Instruments Company	San Diego, Ca.
16758	Delco Radio Div., General Motors	Kokomo, Ind.
16902	Simpson Instruments, Inc.	Escondido, Ca.
17745	Angstrohm Precision, Inc.	Van Nuys, Ca.
17838	Mektron, California General, Inc.	Chula Vista, Ca.
17870	Daven Div., Thomas A. Edison	Manchester, N. H.
18076	Umpco	City of Industry, Ca.
18121	Wilshire Foam Products, Inc.	Gardena, Ca.
18178	Vactec Inc.	Maryland Heights, Mo.
18324	Signatics	Sunnyvale, Ca.
18612	Vishay Instruments Inc.	Malvern, Pa.
18677	Scambe Mfg. Co.	Monterey Park, Ca.
18702	Ducommun Metals and Supply Co.	Los Angeles, Ca.
18722	R C A	Mountaintop, Pa.
19080	The Robinson Company	Hawthorne, Ca.
19781	Potter Company	Sun Valley, Ca.
20857	South Bay Cable Corp.	Gardena, Ca.
21604	Buckeye Stamping Company	Columbus, Ohio
22599	Elastic Stop Nut Corporation	Van Nuys, Ca.
23039	Deccofelt Products Company	Glendora, Ca.
23050	Product Components Corp.	Hastings-on-Hudson, N. Y.
23783	British Radio Electric Ltd.	Washington, D. C.
23936	Pamotor, Incorporated	San Francisco, Ca.
24796	Parelco Inc.	Paramount, Ca.
24931	Specialty Connector Co., Inc.	Indianapolis, Ind.
25684	Victoreen Instrument Co., Inc.	Oak Lawn, IN.
25706	Daburn Electronics and Cable Corp.	New York, N. Y.
26528	Lamcor, Incorporated	Anaheim, Ca.
26533	Zero Manufacturing Company	Burbank, Ca.
27014	National Semi-Conductor Corp.	Santa Clara, Ca.
27191	Cutler-Hammer, Inc.	Milwaukee, Wisc.
27556	IMB Electronic Products	Santa Fe Springs, Ca.
27683	Varo, Incorporated	St. Garland, Tex.
28480	Hewlett-Packard Co.	Palo Alto, Ca.
28520	Heyman Mfg. Company (Heyco)	Kenilworth, N. J.
30086	I-T-E Circuit Breaker Co.	Philadelphia, Pa.
30817	Instrument Specialties Co.	Little Falls, N. J.
30983	Electra/Midland	San Diego, Ca.
42190	Muter Company	Chicago, Ill.
44655	Ohmite Manufacturing Company	Skokie, Ill.
45722	Parker-Kalon	Clifton, N. J.
46384	Penn. Eng. and Mfg. Corp.	Doylestown, Pa.
56289	Sprague Electric Company	North Adams, Mass.
58474	Superior Electric Company	Bristol, Ct.
59730	Thomas and Betts Company	Elizabeth, N. J.
60741	Triplett Electrical Instrument Co.	Bluffton, Ohio
63743	Ward Leonard Electric Co.	Mt. Vernon, N. Y.
70903	Belden Manufacturing Co.	Chicago, Ill.
71002	Birnbach Radio Company, Inc.	New York, N. Y.
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
71400	Bussmann Mfg. Div., McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corporation	Elkhart, Ind.
71468	ITT Cannon Electric, Inc.	Los Angeles, Ca.
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, Wis.
71744	Chicago Miniature Lampworks	Chicago, Ill.
71785	Cinch Manufacturing Company	Chicago, Ill.
72136	Elmenco (Electro Motive)	Willimantic, Ct.
72259	Nytronics, Incorporated	Berkeley Heights, N. J.
72619	Dialight Corporation	Brooklyn, N. Y.
72982	Erie Technological Products, Inc.	Erie, Pa.
73138	Beckman Instruments, Inc.	Fullerton, Ca.
73559	Carling Electric, Inc.	West Hartford, Ct.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73899	J F D Electroncis Company	Brooklyn, N. Y.
73949	Guardian Electric Mfg. Co.	Chicago, Ill.
73957	Groov-Pin Corporation	Ridgefield, N. J.
74193	Heinemann Electric Company	Trenton, N. J.
74276	Signalite, Incorporated	Neptune, N. J.
74542	Hoyt Electrical Instrument Works	Penacook, N. H.
74545	Harvey Hubbel, Inc.	Bridgeport, Ct.
74970	E. F. Johnson Company	Waseca, Minn.
75382	Kulka Electric Corporation	Mt. Vernon, N. Y.
75915	Littelfuse, Incorporated	Des Plaines, Ill.
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, Ind.
76348	Miller Products Company	New York, N. Y.
76493	J. W. Miller Company	Los Angeles, Ca.
76854	Oak Manufacturing Company	Crystal Lake, Ill.
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, Ind.
78189	Shakeproof Div., Illoms Tool Works	Chicago, Ill.
78299	Struthers-Dunn, Incorporated	Pitman, N. J.
78488	Stackpole Carbon Company	St. Marys, Pa.
78526	Stanwyck Winding Company, Inc.	Newburgh, N. Y.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78947	Ucinite Company	Newtonville, Mass.
79130	Johns-Manville Products Corp.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Phila., Pa.
79963	Zierick Mfg. Corporation	New Rochelle, N. Y.
80112	G. C. Electronics Company	Los Angeles, Ca.
80223	United Transformer Co.	New York, N. Y.
80294	Bourns, Incorporated	Riverside, Ca.
80368	Sylvania Electric Products, Inc.	New York, N. Y.
81073	Grayhill, Incorporated	La Grange, Ill.
81095	Triad Transformer Corp.	Venice, Ca.
81312	Winchester Electronics	Oakville, Ct.
81349	Military Spec., Standardization Division, Directorate of Logistic Services DSA	
82389	Switchcraft, Incorporated	Chicago, Ill.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N. Y.
83058	Car Fastener Company	Cambridge, Mass.
83324	Rosan, Incorporated	Newport Beach, Ca.
83330	Herman H. Smith, Inc.	Brooklyn, N. Y.
83594	Burroughs Corporation	Plainfield, N. J.
83701	Electronic Devices, Incorporated	Yonkers, N. Y.
84171	Arco Electronics, Inc.	Great Neck, N. Y.
86684	R C A	Harrison, N. J.
87034	Marco-Oak Industries	Anaheim, Ca.
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, Ca.
90201	Mallory Capacitor Company	Indianapolis, Ind.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corporation	Willow Grove, Pa.
91812	Janco Corporation	Burbank, Ca.
91833	Keystone Electronics Corp.	New York, N. Y.
91929	Micro Switch Div., Honeywell, Inc.	Freeport, Ill.
92194	Alpha Wire Corporation	Elizabeth, N. J.
92219	Waldom Electronics, Inc.	Chicago, Ill.
93332	Sylvania Electric Products, Inc.	Woburn, Mass.
94222	Southco, Incorporated	Lester, Pa.
95146	Alco Electronics Products	Lawrence, Mass.
95303	R C A	Cincinnati, Ohio
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, Ill.
96682	Genisco, Incorporated	Compton, Ca.
97525	Electronic Engineering Co.	Santa Ana, Ca.
97954	U. S. Components, Incorporated	Bronx, N. Y.
98159	Rubber Teck, Incorporated	Gardena, Ca.
98278	Microdot, Incorporated (Lerco)	S. Pasadena, Ca.
98978	IERC	Burbank, Ca.
99392	STM Corporation	Oakland, Ca.
99515	Marshall Industries	Monrovia, Ca.
99517	Vacco Industries	El Monte, Ca.
99800	Delevan Electronics Corporation	Aurora, N. Y.
99742	Permacel Div., Johnson and Johnson	New Brunswick, N. J.

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